United States Department of Agriculture

Natural Resources Conservation Service

DRAFT

Supplemental Environmental Impact Statement
Little Otter Creek Watershed Plan

PREPARED BY:

UNITED STATES DEPARTMENT OF AGRICULTURE

NATURAL RESOURCES CONSERVATION SERVICE

IN COOPERATION WITH:

CALDWELL COUNTY COMMISSION

CALDWELL COUNTY SOIL AND WATER CONSERVATION DISTRICT

COOPERATING FEDERAL AGENCY:

UNITED STATES ARMY CORPS OF ENGINEERS.

SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT
LITTLE OTTER CREEK WATERSHED PLAN
CALDWELL COUNTY, MISSOURI

PREPARED BY:

United States Department of Agriculture - Natural Resources Conservation Service

IN COOPERATION WITH:

Caldwell County Commission

Caldwell County Soil and Water Conservation District

Cooperating Federal Agency: United States Army Corps of Engineers

AUTHORITY:

This document was prepared under the authority of the Watershed Protection and Flood Prevention Act, Public Law (PL) 83-566, as amended (16 U.S.C. 1001-1008)

ABSTRACT:

The United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) has prepared this supplemental environmental impact statement (SEIS) for the Little Otter Creek Watershed Plan that includes the proposed Little Otter Creek Reservoir (Proposed Action). This document is a SEIS only as there have been no substantive changes to the original watershed plan. A final EIS (FEIS) and record of decision (ROD) were completed in 2003 (https://www.nrcs.usda.gov/wps/portal/nrcs/mo/water/). This SEIS is intended to supplement and update information presented in the 2003 FEIS, including an expanded alternatives analysis that complies with National Environmental Policy Act (NEPA) and Clean Water Act (CWA) Section 404(b)(1) guidelines. This SEIS documents changes that have occurred since the original FEIS and ROD were published. This SEIS is not intended to be a stand-alone document, but rather a supplement to the 2003 FEIS.

The FEIS and SEIS identified three project purposes: 1) to provide a dependable long-term water supply to meet a projected 50-year demand for Caldwell County residents; 2) to provide water-based recreation to help meet the unmet demand for Caldwell County and areas within the 25-mile recreation market area (RMA); and 3) to reduce flood damages on 3.8 miles of Little Otter Creek between Northeast Jefferson Drive and the confluence with Otter Creek. A needs analysis determined that the project must provide a dependable, affordable water supply that meets the long-term demand of 1.24 million gallons per day; provides at least 45,000 annual user-days of water-based recreational opportunities and reduces annual flood damages by at least $64,200. A range of reasonable alternatives were evaluated for each of the three project purposes independently and then combined, if needed, to create a multipurpose project.

The preferred alternative, determined from the analyses in the FEIS and this SEIS, is Little Otter Creek Reservoir. This alternative creates a 344-acre multipurpose reservoir that would meet the project purposes of water supply and water-based recreation in Caldwell County and would reduce flood damage along Little Otter Creek. This alternative was determined to be the National Economic Development alternative in the FEIS. The no action and action alternatives were carried forward for a more detailed evaluation of social, economic, and natural environmental resources and potential impacts to these resources. No known threatened and endangered species or cultural sites would be affected by the Proposed Action.

COMMENTS AND INQUIRIES:

Comments and inquiries must be received by May 14, 2019. Submit comments and inquiries to: Chris Hamilton, Assistant State Conservationist (Water Resources), Missouri NRCS State Office, 601 Business Loop 70W, Suite 250, Columbia, MO 65203; telephone: 573.876.0912; email: chris.hamilton@mo.usda.gov.

SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT
LITTLE OTTER CREEK WATERSHED PLAN
CALDWELL COUNTY, MISSOURI
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AJD	Approved Jurisdictional Determination
BCID	Bat Call Identification Software
BMP	Best Management Practice
CARES	Center for Applied Research and Environmental Systems
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CRP	Conservation Reserve Program
CWA	Clean Water Act
DSEIS	Draft Supplemental Environmental Impact Statement
EO	Executive Order
ESA	Endangered Species Act
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
GIS	Geographic Information System
gpcd	Gallons per Capita Day
gpm	Gallons per Minute
LEDPA	Least Environmentally Damaging Practicable Alternative
LF	Linear Foot
LOCWWC	Little Otter Creek Wholesale Water Commission
MBTA	Migratory Bird Treaty Act
MDC	Missouri Department of Conservation
MDNR	Missouri Department of Natural Resources
mgd	Million Gallons per Day
MoDOT	Missouri Department of Transportation
MSA	Metropolitan Statistical Area
NEPA	National Environmental Policy Act
NHD	National Hydrography Dataset
NLCD	National Land Cover Database
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory
PCC	Project Capital Cost
PER	Preliminary Engineering Report
PPWV	Present Worth Value
PL	Public Law
PO&M	Present Worth of Uniform Series of Annual Operation and Maintenance Cost
PWSD	Public Water Supply District
RCRA	Resource Conservation and Recovery Act
RESOP	Reservoir Operation Study Computer Program
RMA	Recreation Market Area
ROD	Record of Decision
S	Salvage Value

SCORP	Statewide Comprehensive Outdoor Recreation Plan
SEIS	Supplemental Environmental Impact Statement
USACE	United States Army Corps of Engineers
U.S.C.	United States Code
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

SUMMARY

(OFFICE OF MANAGEMENT AND BUDGET FACT SHEET)

Supplemental Environmental Impact Statement (SEIS) for the
Little Otter Creek Watershed Plan
Caldwell County, Missouri
Missouri Fifth Congressional District

Authority: This document was prepared under the authority of the Watershed Protection and Flood Prevention Act, Public Law (PL) 83-566, as amended (16 United States Code [U.S.C.] 1001-1008).

Sponsors: Caldwell County Commission; Caldwell County Soil and Water Conservation District

Cooperating Federal Agency: United States Army Corps of Engineers (USACE)

Caldwell County, Missouri, through their elected Commission, is the local sponsor of a project to provide a reliable water supply; water-based recreational opportunities and to reduce flood damages. The proposed action is to construct a 344-acre multipurpose reservoir, which will require the discharge of fill material into jurisdictional waters of the U.S. and will therefore require a permit from the United States Army Corps of Engineers (USACE) under Section 404 of the Clean Water Act (CWA). The USACE has requested that a supplemental environmental impact statement (SEIS) be prepared to provide information to support a CWA Section 404 permit application. The USACE issued an approved jurisdictional determination (AJD) that identified the limits of wetlands and other waters of the U.S. in 2010 and reissued it 2015.

In compliance with National Environmental Policy Act (NEPA) requirements and 404(b)(1) guidelines, this SEIS considers a range of reasonable alternatives that will assist the USACE in selecting the least environmentally damaging practicable alternative (LEDPA). As required by NEPA, this SEIS provides an objective and thorough assessment of the potential impacts of the reasonable alternatives. In particular, the SEIS documents the changes that have occurred since the original final environmental impact statement (FEIS) and record of decision (ROD) were published in 2003. This document is a SEIS only as there have been no substantive changes to the original watershed plan. This SEIS is not a stand-alone document but is a supplement to the 2003 FEIS (https://www.nrcs.usda.gov/wps/portal/nrcs/mo/water/).

Proposed Action: The proposed action is to construct an earthen dam forming a reservoir large enough to provide a dependable water supply for Caldwell County; water-based recreation, and to reduce flood damages. Providing water from the proposed reservoir to the citizens of Caldwell County will require transmission to a water treatment plant and distribution of the treated water to users. The proposed project site is centrally located in the county. A water treatment plant is planned to be built by the Little Otter Creek Wholesale Water Commission (LOCWWC) to treat the raw water provided by the Proposed Action. The distribution of finished water will use existing lines where possible. The LOCWWC, created by water users and suppliers in anticipation of the Proposed Action, will make future and final decisions on how the water supply is treated and distributed.

The water treatment plant and distribution lines are not part of the proposed action; however they are considered a connected action required to meet future demand. There are currently 14 different water supply systems that operate wholly or partially in Caldwell County providing retail water to the residents and businesses. Currently, there is no distribution network that links these 14 systems together. A conceptual water treatment and distribution network is evaluated as a connected future action.

Purpose and Need for Action: The sponsor and NRCS have identified a need for three project purposes: water supply, water-based recreation, and flood damage reduction. The Caldwell County Commission and the Missouri Department of Natural Resources (MDNR) have identified the need for an adequate, dependable, and high-quality raw water supply for the public water supply districts (PWSD) and municipalities serving residents and businesses in Caldwell County. This region has been affected by droughts and water shortages for many years and most recently in 2018. Lack of water has created personal hardships for county residents and has limited potential growth. In addition, there is a need to reduce damages from flooding on a 3.8-mile reach of Little Otter Creek where localized flooding occurs routinely and where major flooding has occurred in the past. Further, there is a need to meet the unmet demand for water-based recreational opportunities in Caldwell County.

Description of Proposed Action: The Proposed Action is construction of an earthen dam on Little Otter Creek to create a 344-acre multipurpose reservoir located 3.5 miles southeast of Hamilton, Missouri, that would provide water supply and water-based recreation for Caldwell County and would reduce flood damages along a 3.8-mile reach of Little Otter Creek between Northeast Jefferson Drive and its confluence with Otter Creek.

Resource Information:

Latitude & Longitude (centroid of watershed): 39.716195 degrees north latitude, -93.945163 degrees west longitude

Watershed Size: 6,323 acres

Current Watershed Land Uses (Little Otter Creek):

- Farmland – 2,027 acres
  - Prime Farmland – 564 acres
  - Farmland of Statewide Importance – 495 acres
  - Other Farmland – 968 acres
- Pasture – 3,210 acres
- Grassland – 33 acres
- Shrub / Scrub – 11 acres
- Forestland – 488 acres
  - Deciduous Forest – 485 acres
  - Evergreen Forest – 3 acres
- Wetlands – 44 acres
  - Woody Wetlands (Freshwater Forested/Shrub Wetland)– 36 acres
  - Emergent Herbaceous Wetlands (Freshwater Emergent Wetland)– 8 acres
- Open water – 123 acres
  - Freshwater Pond – 56 acres

  - Riverine – 67 acres
- Urban – 387 acres

Caldwell County Land Ownership:

Private – 98 percent
Federal, State, and Local Government – 2 percent

Caldwell County Population: 9,424 (U.S. Census 2010)

Alternatives Considered: A range of reasonable alternatives were considered for each of the three project purposes and then screened to determine whether the individual alternative met the individual purpose. Those alternatives that met the individual purpose screening criteria were then combined (if needed) with alternatives from the other purposes to create multipurpose alternatives that met all three of the project purposes and needs.

Water Supply Purpose

A range of reasonable alternatives to meet the need for water supply were developed by the Natural Resources Conservation Service (NRCS) and agreed upon by an interagency review team. The list of alternatives was developed after defining the water supply project purpose as follows: “to provide a dependable long-term water supply to meet a projected 50-year demand for Caldwell County municipalities and residents.”

Water supply alternatives that were evaluated included groundwater sources, connection to existing systems, streams and rivers, existing lakes, creation of a new reservoir, or a combination of these alternatives. A No Action alternative was also evaluated.

Each alternative was evaluated for preliminary environmental impacts and costs and was screened for its ability to meet the water supply purpose and need by the following criteria:

- Reliably provide 1.24 million gallons per day (mgd) of water during a drought equivalent to the drought of the 1950s (this is the Missouri design standard)
- Comply with existing codes and regulations
- Provide raw or finished water of a quality that can be brought to current and future drinking water standards using available treatment methods
- Provide water through willing participation of potential suppliers

Flood Damage Reduction Purpose

A range of reasonable alternatives were developed to meet the need for flood damage reduction which is defined as follows: “Reduce flood damages on 3.8 miles of Little Otter Creek between Northeast Jefferson Drive and the confluence with Otter Creek.”

Alternatives evaluated included zoning, floodplain acquisition, conservation measures, wetland storage areas, streamflow alteration and conveyance, levees and the raising of bridges, valley encroachment berms, small detention structures, dry dam detention 100-year storage, dry dam detention 50-year storage, Little Otter Creek Reservoir (Proposed Action), and a combination of alternatives. These alternatives were evaluated by the following criteria:

- Provide substantial flood damage reduction

- Comply with existing state and federal codes and regulations
- Mitigate peak flow in a timely manner, without increasing peak flows

Water-Based Recreational Opportunity Purpose

A range of reasonable alternatives was developed to meet the need for recreation which is defined as follows: "Provide water-based recreation to help meet the unmet demand for Caldwell County and the 25-mile recreation market area (RMA)."

Alternatives to meet recreation needs included creating new stream access, expanding and improving existing private lake access, developing a series of ponds, and developing an alternative reservoir location. These alternatives were screened by the following criteria:

- Provide a full range of water-based recreational activities such as fishing and no-wake boating/sailing/canoeing/kayaking
- Meet or exceed 45 percent of the presently unmet user-day demand, or 45,000 user-days, for adequate water-based recreational opportunities
- Be available for public use and have public access, including reasonable parking and walking lanes for access to water-based recreation

Multipurpose Alternatives Considered: Following screening of alternatives that met any of the three individual project purposes and needs of water supply, water-based recreation, or flood damage reduction, alternatives were combined (if necessary) to meet the three project purposes. The new alternatives identified and evaluated include the following:

- No Action
- Proposed Action – Little Otter Creek Reservoir
- Alternative Reservoir Location – Site 4 and Floodplain Acquisition
- Alternative Reservoir Location – Site 5 and Floodplain Acquisition

Proposed Action Installation Costs: The Proposed Action installation costs are detailed in Appendix B and are based on a range of assumptions that are used in the alternatives analysis.

Proposed Action Benefits: Proposed Action benefits include improved quality of life resulting from installation of an adequate and dependable water supply source, reduced flood damages, and increased recreational opportunities.

Water Supply Benefits. The 2003 FEIS determined that an adequate and dependable water supply is not available to the municipalities and PWSD serving residents of Caldwell County. If the 1950s drought of record were to occur today, the water supply could not meet current demand. This inadequacy contributes to the high cost of water as a percentage of income in Caldwell County, compared to elsewhere in the state of Missouri. Lack of affordable, dependable water is a human health, public safety, economic, and quality-of-life issue. The Proposed Action would provide a dependable water supply through the drought of record. Many water suppliers in the region have closed or have faced operational uncertainty due to challenges in meeting state drinking water quality standards. A local water source that provides an adequate and dependable water supply would lower costs through economies of scale, meet the current water demand during the drought of record, provide resilience to climate change, promote business development, lower fire insurance rates, and allow for growth in water use.

Water-Based Recreation Benefits. The Proposed Action would provide water-based recreational opportunities to help meet the unmet demand in Caldwell County. The Proposed Action would provide fishing and wildlife recreational opportunities. It would also provide habitat for aquatic and terrestrial species associated with reservoirs. The reservoir would feature a wide range of habitats including open water, shallow mud flats, flooded timber, and lacustrine riparian areas. Aquatic species such as largemouth bass, walleye, crappie, catfish, and bluegill could be stocked in coordination with the Missouri Department of Conservation (MDC) and would provide fishing opportunities. Avian species including bald eagles, migratory waterfowl, and shorebirds could benefit from the increased variety of aquatic habitats and would provide birding and wildlife viewing opportunities for visitors and residents. Increased recreational opportunities could also provide economic benefits by diversifying the local economy to provide visitor services.

Flood Damage Benefits. Flood damages have been documented frequently along the 3.8-mile reach of Little Otter Creek between Northeast Jefferson Drive and its confluence with Otter Creek. Flooding along this reach has damaged crops, scoured topsoil, flattened fences, threatened bridges and rutted county roads. The Proposed Action would reduce flood damages to the properties affected by Little Otter Creek flooding and it would reduce risks to life and property.

Environmental Impacts: The SEIS identifies potential impacts from the Proposed Action.

Farmland

Under the Farmland Protection Policy Act, federal agencies must identify and take into account the effects of federal actions on prime or unique farmland. Prime farmland and farmland of statewide importance designate soils that could provide farming benefits and do not necessarily indicate land that is currently being farmed. There are currently 104 acres of land currently being farmed within the project footprint. According to the NRCS Soil Survey (2017), an estimated 186 acres of land designated prime farmland and 24 acres designated farmland of statewide importance are within the project footprint and would be inundated by the Proposed Action. This represents 33 percent of the total prime farmland and 4.8 percent of the total farmland of statewide importance within the Little Otter Creek watershed. This also represents 1.3% of the total prime farmland and 0.1% of the total farmland of statewide importance in Caldwell County.

Forest

Forestland within the Little Otter Creek watershed comprises an estimated 488 acres. Forestland within the Proposed Action project footprint comprises an estimated 98 acres or 20 percent of the watershed. Forest types are predominantly central hardwoods with the only native conifer being eastern red cedar. The forest stands are unmanaged second-growth timber and are generally in poor condition. Many of the woodlots are grazed.

Wetlands

Wetlands within the project area were delineated in 2009, and an AJD was issued in 2010. The USACE reissued the AJD in 2015. According to the AJD, an estimated 4.1 acres of wetlands were identified within the footprint of the Proposed Action (USACE 2010). This 4.1 acres represents 2.5% of the total wetlands in the Little Otter Creek Watershed. Wetlands affected by the Proposed Action will be mitigated for in accordance with USACE 404 permit requirements.

Streams

Implementing the Proposed Action would result in an estimated 36,243 feet of stream impacts because of inundation and dam construction (USACE 2010). Changes in fish diversity below the reservoir may occur. Changes in flow regime and temperature may adversely affect species sensitive to changes in water temperature and flow. Twelve common fish species have been identified in the project area: central stoneroller, red shiner, redfin shiner, golden shiner, bigmouth shiner, bluntnose minnow, fathead minnow, creek chub, black bullhead, green sunfish, bluegill, and Johnny darter. The bluntnose minnow, fathead minnow, black bullhead, green sunfish, and bluegill are very tolerant species of a wide range of water quality conditions. No threatened or endangered fish species, fisheries of concern, or essential fish habitats are present within the water bodies in the project study area.

Terrestrial Vegetation

Terrestrial vegetation provides habitat for many wildlife species. The most common land cover types that would be affected by the Proposed Action are cultivated cropland, pasture land, and deciduous forest. Vegetation within the pasture areas is comprised of cool and warm season plants. Pastures include a species mix of tall fescue (*Lolium arundinaceum*), smooth brome (*Bromus inermis*), or a Conservation Reserve Program (CRP) mix dominated by big bluestem (A*ndropogon gerardii*), little bluestem (*Schizachyrium scoparium*), Indiangrass (*Sorghastrum nutans*), and switchgrass (*Panicum virgatum*). Loss of species diversity and introduction of invasive, non-native species is typical of the region. The understory of the forested areas consists mostly of coral berry (*Symphoricarpos orbiculatus*) and Virginia wildrye (*Elymus virginicus*). The forested areas consist mainly of hackberry (*Celtis occidentalis*) and black walnut (*Juglans nigra*).

Wildlife

Typical wildlife for the areas affected by the normal pool includes white-tailed deer, turkeys, coyotes, raccoons, opossums, striped skunks, squirrels, snakes, turtles, and frogs. Forested areas, trees, and brush thickets associated with the riparian corridor may provide nesting habitat for nesting migratory bird and eagle species. The deciduous forest may provide nesting, foraging, and cover habitat for many species of birds, raptors, bats, deer, coyotes, and small mammals. Vegetation removal for construction of the Proposed Action would decrease the amount of upland habitat available in the project area. Mobile species, such as most birds and larger mammals, would be expected to move out of the project area once construction activities commence.

Threatened and Endangered Species

Topeka shiner (*Notropis topeka*) and Indiana bat (*Myotis sodalis*) are federally endangered species identified as occurring in Caldwell County. The northern long-eared bat *(Myotis septentrionalis)* is federally threatened and is listed under the U.S. Fish and Wildlife Service's (USFWS) 4(d) rule.

In 2001, MDC conducted a survey of the fish community to determine the presence of the Topeka shiner. No Topeka shiners were found during the 2001 survey (NRCS 2003). A Little Otter Creek Topeka shiner survey was completed in December 2015 following an approved USFWS methodology that covered all 160 pools within the Proposed Action location and 2 miles upstream and downstream. No Topeka shiners were found during that survey (MSU 2015a).

A mist netting survey and acoustic monitoring study were conducted in 2015 following an approved USFWS methodology at the Proposed Action location to determine the presence or probable absence of the Indiana bat or the northern long-eared bat. Two species were captured in mist nets: the big brown bat (*Eptesicus fuscus*) and the eastern red bat (*Lasiurus borealis*). Neither the Indiana bat nor the northern long-eared bat were found (MSU 2015b). Coordination with USFWS is ongoing.

A survey for the plains spotted skunk (*Spilogale putorius interrupta*), which is a state endangered species, was not conducted. MDC best management practices (BMPs) will be followed, and if necessary, coordination with MDC will be conducted on this species.

Project construction activities may lead to temporary short-term impacts. These impacts typically include such things as construction noise, traffic accommodations during construction activities, access to adjoining properties, and construction accommodations needed to build the project. No long-term noise impacts are anticipated. An increase in recreational opportunities within the area may result in an increase of visitors; however, traffic and noise associated with recreation would be incremental and seasonal.

Benefit/Cost Analysis:

Probable installation costs of the Proposed Action include:

Construction	$ 11,790,000
Engineering	$ 1,179,000
Land	$ 1,656,000
Recreation	$ 499,000
Mitigation	$ 2,000,000
Total Cost	$17,120,000 (rounded)

Comparison of Benefits and Costs 2001 FEIS Discount Rate (6.125%)						
Proposed Action	Average Annual Benefits				Average Annual Cost	Benefit/ Cost Ratio
	Water Supply Benefits	Flood Damage Reduction Benefits	Recreation Benefits	Total Benefits		
Little Otter Creek Reservoir (MA1)	**$705,500**	**$89,700**	**$375,900**	**$1,171,100**	**$1,119,800**	**1.05**

Comparison of Benefits and Costs, 2018 Water Resources Discount Rate (2.75%)						
Proposed Action	Average Annual Benefits				Average Annual Cost	Benefit/ Cost Ratio
	Water Supply Benefits	Flood Damage Reduction Benefits	Recreation Benefits	Total Benefits		
Little Otter Creek Reservoir (MA1)	**$346,300**	**$89,700**	**$375,900**	**$811,900**	**$572,736**	**1.42**

Major Conclusion: The Little Otter Creek Watershed Plan will have a major beneficial effect on the problems of an inadequate, undependable water supply; unmet demand for recreational opportunities; and floodwater damages in Caldwell County. Federal water planning guidelines

(USWRC, 1983) establish standards and procedures for use by Federal agencies in formulating and evaluating alternative plans for water and related land resources implementation studies. Alternative plans are to be formulated in a systematic manner to ensure that all reasonable alternatives are evaluated. A plan that reasonably maximizes net national economic development benefits, consistent with the Federal objective, is to be formulated. This plan is to be identified as the National Economic Development (NED) plan. The Proposed Action is the National Economic Development alternative. Construction of a dam and reservoir will cause unavoidable environmental impacts. After avoiding and minimizing impacts, unavoidable impacts will be mitigated in accordance with an approved compensatory mitigation plan.

Areas of Controversy: No significant unresolved issues or controversies have been identified.

Compliance with Executive Orders, Public Laws, and Other Statues: This document was prepared under authority of the Watershed Protection and Flood Prevention Act, PL 83-566, as amended (16 U.S.C. 1001-1008); and in accordance with Section 102(2)(c) of NEPA of 1969, PL 91-190, as amended (42 U.S.C. 4321 et seq.). This document is in compliance with executive orders, public laws and other statutes governing the formulation of water resources projects.

1.0 Introduction and Purpose and Need

2.0 Alternatives Analysis

3.0 Affected Environment and Predicted Environmental Consequences

4.0 Cumulative and Growth-Inducing Effects

5.0 Comparison of Alternatives and Mitigation

6.0 Compliance and Consultation with Applicable Laws, Policies, and Plans

7.0 Public Involvement

8.0 List of Preparers

9.0 Distribution List

10.0 Reference

1.0 Introduction

The United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) has prepared this supplemental environmental impact statement (SEIS) for the Little Otter Creek Watershed Plan. The NRCS is the lead federal agency for compliance with the National Environmental Policy Act (NEPA). This supplement updates information and analyses contained in the final environmental impact statement (FEIS) of the Little Otter Creek Watershed Plan, which was published in March 2003 (NRCS 2003a). A record of decision (ROD) was published for that project in May of 2003 (NRCS 2003b).

Caldwell County, Missouri is the local sponsor of this project to provide water supply, flood damage reduction, and water-based recreation opportunities. The project location is 38 miles from the city limits of Kansas City, Missouri. Interstate 35 (I-35) runs north and south immediately west of the county (Figure 1.0-1).

The alternative that was selected in the FEIS (construction of the Little Otter Creek Reservoir) will require the discharge of fill material into jurisdictional waters of the U.S., necessitating a permit from the United States Army Corps of Engineers (USACE) under Section 404 of the Clean Water Act (CWA). The USACE requested that a SEIS be prepared to evaluate a range of alternatives to the Little Otter Creek Reservoir. This SEIS evaluates the potential environmental effects of constructing and operating a reservoir and associated facilities, as well as alternatives to the Little Otter Creek Reservoir.

The USACE issued an approved jurisdictional determination (AJD) in 2010 and reissued it in 2015. The AJD identified the limits of waters of the U.S., including streams and wetlands, in the Little Otter Creek project area (USACE 2010) through field verification methods.

The USACE requested that this SEIS incorporate the AJD and conduct an alternatives analysis that would allow the USACE to determine the least environmentally damaging practicable alternative (LEDPA) under Section 404(b)(1) guidelines. The CWA Section 404(b)(1) guidelines require that the LEDPA is the alternative that can be permitted under Section 404. Alternatives analysis is included in this SEIS to support a Section 404 permit application. More detailed information is available for the Proposed Action but for consistency in comparing all alternatives on the same basis, wetland impacts were based on the National Wetlands Inventory (NWI) data, and stream impacts were based on National Hydrography Dataset (NHD).

NEPA compares “reasonable” alternatives which take into consideration costs, logistics, and existing technology. This SEIS provides an objective and thorough assessment of the potential impacts of reasonable alternatives that meet the project purpose and need. The SEIS addresses changes that have occurred since the 2003 FEIS and ROD. In addition, this SEIS provides information to assist the USACE render its Section 404 permit decision. The supplemental information in this document focuses on complying with both NEPA and the CWA Section 404(b)(1) guidelines. This SEIS incorporates the best available data at the time of preparation.

The alternatives analysis focuses primarily on impacts to aquatic resources and on practicability of the project. Practicability means an alternative is available and capable of being done, taking into consideration cost, logistics, and technology. For NEPA, the SEIS will review and update natural, social, economic, and environmental resources. Section 1.4 contrasts the two processes in greater detail. Both processes will consider the public interest in order to adopt an alternative

that meets the project purpose and need. This SEIS is not intended as a stand-alone document, but is a supplement to the 2003 FEIS, which can be found along with other background documentation at the Missouri NRCS and Caldwell County websites:

Missouri NRCS: https://www.nrcs.usda.gov/wps/portal/nrcs/mo/water/

Caldwell County: http://caldwellco.missouri.org/

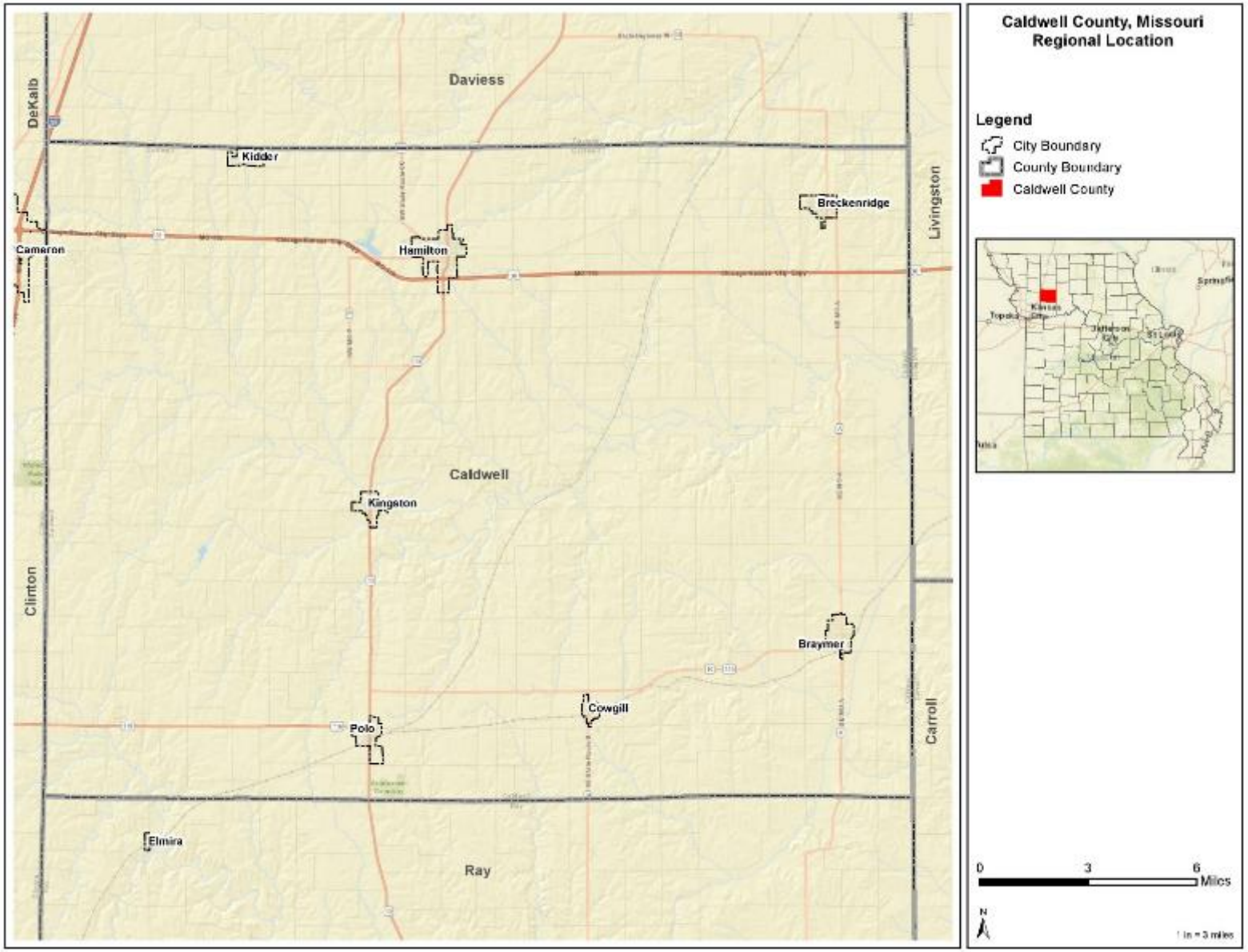


Figure 1.0-1. Caldwell County Regional Location.

1.1 History and Background

Caldwell County includes the communities of Braymer, Breckenridge, Cowgill, Hamilton, Kidder, Kingston, Mirabile, and Polo, along with unincorporated areas. The 2003 FEIS indicates that the shortage of public drinking water supplies in the county have been the subject of local discussion and engineering reports for over 50 years (NRCS 2003a).

Underlying geologic formations severely limit groundwater quality and availability. The *Missouri Drought Plan* (MDNR 2002) places Caldwell County in a region classified as having "severe surface and groundwater supply drought vulnerability." Digital models estimate that existing water sources could supply only 37 percent of the county's current demand during the drought of record. According to the *Missouri Water Supply Study* as revised (Edwards et al. 2011), the drought of record occurred between 1951 and 1959. On July 17, 2012, Caldwell County received a disaster declaration by the Secretary of Agriculture because of drought and excessive heat. In addition, the county has identified other water-related problems such as a lack of outdoor recreation for its citizens and frequent flood events that damage infrastructure and cropland.

According to the FEIS (NRCS 2003), at the request of the Caldwell County Commission and the Caldwell County Soil and Water Conservation District, the NRCS began watershed planning activities in July 2000 under the authority of the Watershed Protection and Flood Prevention Act of 1954, Public Law (PL) 83-566, as amended (16 United States Code [U.S.C.] 1001-1008). NRCS issued a notice of intent to prepare an environmental impact statement in July of 2002. On August 6, 2002, the voters of Caldwell County approved a one-half percent sales tax to assist in funding the local match for project installation. In 2003, the NRCS completed a watershed plan and FEIS in compliance with NEPA for issuing federal funds under PL 83-566. The recommended plan alternative consisted of a multipurpose reservoir.

The 2003 FEIS recommended plan is described as the following (page 1 of the 2003 FEIS; NRCS 2003):

"The recommended plan consists of installation of one [multipurpose] reservoir and development of basic facilities for recreational use. The [multipurpose] reservoir will provide locally controlled agricultural water management (rural water supply); fish and wildlife habitat enhancement; recreational development and flood prevention."

The Proposed Action purposes detailed on page 4 of the 2003 FEIS were stated as the following:

- *To provide an adequate, dependable, locally controlled water supply system for the rural areas and municipalities within Caldwell County*
- *To improve recreational opportunities by providing a site for fishing, hiking, picnicking, and nature studies*
- *To reduce flood damages in the downstream areas of the Little Otter Creek floodplain*

The 2003 FEIS identified the following problems in the project area:

- An inadequate and undependable rural water supply system for the residents of Caldwell County
- Damages to crops, pastures, fences, roads, and bridges because of flooding
- A decrease in farm income and an increase maintenance caused by flooding
- Limited public water-based recreational facilities within 25 miles of the project area

Following the issuance of the ROD, NRCS continued to move the project forward by completing plans and specifications for the dam. After these were completed in 2008, NRCS began the process of obtaining a jurisdictional determination of waters of the U.S. present within proposed action project area, along with a CWA Section 404 authorization from the USACE. The USACE and the United States Environmental Protection Agency (USEPA) issued an approved jurisdictional determination for the Little Otter Creek Watershed Plan in 2010 and reissued it in 2015. After further coordination between the NRCS and USACE, USACE requested that an SEIS be completed for the project to inform the Section 404 permit process. NRCS continues to be the lead federal agency in preparation of the SEIS. Since issuance of the notice of intent to prepare the SEIS on December 23, 2013, NRCS has engaged and collaborated with state and federal agencies to meet the requirements of NEPA and the CWA. To this end, NRCS has coordinated over 40 meetings with agencies to discuss permitting efforts. The NRCS has also led an interagency Ecological Flows Task Force, to minimize the impact of a potential reservoir on the aquatic resources living downstream. Other agencies involved in these efforts include USACE, USEPA, U.S. Fish and Wildlife Service (USFWS), Missouri Department of Conservation (MDC), and Missouri Department of Natural Resources (MDNR).

The 2003 FEIS and ROD recommended the Little Otter Creek Reservoir plan. Caldwell County has purchased the land required to construct the Little Otter Creek Reservoir. The voters of Caldwell County approved a one-half percent sales tax to assist in funding the local match for project installation. The county continues to engage with local citizens and public water supply districts (PWSD) regarding the project. The Little Otter Creek Wholesale Water Commission (LOCWWC) has been established by the City of Braymer, Missouri; PWSD #1 of Caldwell County; PWSD #2 of Caldwell County; and PWSD #3 of Caldwell County. The City of Hamilton joined in January 2017 as a contracting party. The LOCWWC was established to provide funding, construction, acquisition, and operation of a wholesale water system, including establishment of a supply contract and associated future water treatment plant and distribution mains. The LOCWWC has passed a resolution to negotiate a water contract with Caldwell County.

Previous Project Documents

Several documents regarding the Proposed Action have been developed since 1989. Table 1.1-1 below identifies some of the published documents.

Table 1.1-1. Previous Project Documents.

Previous project documents that in part or in whole are background for the analysis of water supply, recreation, and flood control in Caldwell County.		
Year – Month	**Focus**	**Title / Author**
1989 – November	Water Supply	Caldwell County Regional Wholesale Water District, Caldwell County Missouri – Water Supply Study / Rhodes-Sayre & Associates
1991 – May	Lake-based Recreation	Public Lakes Program Acquisition and Development Plan / Missouri Department of Conservation (MDC)
1991 – September	Water Supply, Flood Prevention, Fish and Wildlife Recreation	Shoal Creek Basin Feasibility Study Caldwell County – Multiple-purpose Dam Study for Water Supply, Flood Prevention, Recreation / USDA Soil Conservation Service
1992 – June	Water Supply	Preliminary Engineering Report / Allgeier, Martin, & Associates
1992 – July	Water Supply, Flood Prevention, Water-based Recreation	Standard Form 424 application under PL 83-566 / USDA Soil Conservation Service
2002 – January	Water Supply	Preliminary Engineering Report for Caldwell County Regional Water Supply/ Allstate Consultants
2003 – March	Water Supply, Recreation, Flood Prevention	Little Otter Creek Watershed Plan and Environmental Impact Statement / USDA NRCS
2008 – September	Water Supply, Flood prevention, Recreation	Little Otter Creek Dam Construction Plans and Specifications/NRCS
2009 – March	Water Supply	Little Otter Creek Intake Structure Plans and Specifications / Allstate Consultants
2010 – February	Water Supply	Preliminary Engineering Report for Regional Water Supply for Caldwell County / Allstate Consultants
2010 – March	Waters of the U.S.	Approved Jurisdictional Determination – USACE, USEPA
2011 – June	Water Supply	Missouri Water Supply Studies / Missouri Department of Natural Resources (MDNR)
2011 – September	Water Supply	Supplemental Information and Expanded Alternatives Analysis of Little Otter Creek Watershed Plan / Allstate Consultants
2013 – March	Recreation	2013-2017 Missouri Statewide Comprehensive Outdoor Recreation Plan / MDNR
2015 – March	Waters of the U.S.	Approved Jurisdictional Determination – USACE, USEPA

1.2 Project Purpose and Need for Action

The purposes of the proposed federal action are to:

- Provide a dependable long-term water supply to meet a projected 50-year demand for Caldwell County municipalities and PWSDs

- Provide water-based recreation to help meet the unmet demand for Caldwell County and 25-mile recreation market area (RMA)
- Reduce flood damages on 3.8 miles of Little Otter Creek between Northeast Jefferson Drive and the confluence with Otter Creek

The following sections provide supporting information that shows the need for each project purpose.

1.2.1 Need for Dependable, Long-Term Water Supply

Caldwell County does not have a dependable, affordable long-term water supply. The reasons for this include the following:

- Past closure of small water systems because of poor water quality
- Small suppliers lack local water sources and must purchase water
- Lack of adequate water storage for water systems with local water sources to meet demands in a drought
- Short-term contracts with existing suppliers with no long-term guarantees
- Very few raw water sources are available

The following are some specific examples of these problems:

- Small system closure – The Cities of Polo and Breckenridge water systems at one point had their own local water supplies. However, these are no longer functional because of the degraded quantity and quality of groundwater and surface water. As a result, these municipalities now must purchase water from other water systems.
- Water shortages during droughts – The Hamilton Lake water supply cannot meet the needs of the City of Hamilton and Caldwell County PWSD #2. During a dry period in 2012-2013, Hamilton had only 45 days of raw drinking water left in the reservoir at its lowest point (Schulte 2014). In times such as this, citizens are required to reduce water consumption or haul water from other sources. These shortages are documented in the Hamilton City Council minutes (2012-2013), which reported that Hamilton progressed from Stage I to Stage III water restrictions from August 2012 to February 2013. Stage I restrictions are voluntary; however, Stage II and III restrictions require businesses to reduce water consumption by 30 percent, eliminate water sold for livestock, close the city pool, and limit watering lawns and washing vehicles. Water restrictions because of water shortages were also documented in the Caldwell County News in 1999, 2003, and 2011. The City of Hamilton and Caldwell County PWSD #2 water systems supply water to nearly 25 percent of Caldwell County and supply water to an additional 274 people outside of Caldwell County who are currently served by Caldwell County PWSD #2.

Lack of Local Water Supply Sources

The purpose of a dependable long-term water supply is to provide water to the municipalities and PWSDs serving residents of Caldwell County.

Table 1.2.1-1 shows the water systems that serve Caldwell County and the number of people served by each. Two regions in Caldwell County are not served by any water system. Based on the 2010 census blocks, the estimated population in these two regions is 131 people not served water (U.S. Census 2010).

Table 1.2.1-1. Population Served by Retail Water Systems (U.S. Census 2010; MDNR 2011).

Retail Water System	County	Total Population Served (est.)	Pop. Served in Caldwell County	Percentage of Water System Population in Caldwell County**
Braymer	Caldwell	1,050	1,050	100
Breckenridge	Caldwell	415	415	100
Hamilton	Caldwell	1,750	1,750	100
Kingston	Caldwell	382	382	100
Polo	Caldwell	586	586	100
Caldwell PWSD #1	Caldwell	471	471	100
Caldwell PWSD #2	Caldwell	500	300	60
Caldwell PWSD #3	Caldwell	1,431	1,431	100
Daviess PWSD #2	Daviess	2,160	216	10
Clinton PWSD #3	Clinton	3,200	960	30
Clinton PWSD #4 Sys. 1	Clinton	4,000	800	20
Ray PWSD #1	Ray	2,775	28	1
Ray PWSD #3	Ray	2,547	891	35
Livingston PWSD #1	Livingston	1,320	13	1
Totals	**--**	**22,587**	**9,293***	**--**

*Based on 2010 Census population of 9,424 less 131 people not currently served by any water districts.

**The Percentage of Water System Population in Caldwell County was created using geospatial census block data from the 2010 census and was clipped to the boundaries of each water system. This information was used to estimate the percentage of use in each of these districts that could be attributed to Caldwell County.

Table 1.2.1-1 shows that eight communities and PWSDs are based in Caldwell County, and Table 1.2.1-2 shows that four of these – Breckenridge, Polo, and Caldwell County PWSDs #2 and #3 – have no water sources of their own. These four must purchase water from other providers, both inside and outside Caldwell County. The four Caldwell County water systems with a water source are Braymer, Hamilton, Kingston, and Caldwell County PWSD #1. Braymer, Kingston, and Caldwell County PWSD #1 treat groundwater drawn from wells in alluvial or glacial deposits, and Hamilton relies on Hamilton Lake along with water from Livingston PWSD #4 in dry periods.

An additional six PWSDs that serve Caldwell County residents are based outside the county. None of these PWSD has its own water source and must purchase water from other water systems further removed from Caldwell County.

To summarize, of the 14 water supply systems that serve residents within Caldwell County, only four have their own water sources, and several purchase water from other suppliers who also do not have a water source. The shortage of water sources contributes to the lack of dependability and reliability of water for Caldwell County municipalities.

Insufficient Long-Term Water Sources

Caldwell County has a shortage of raw water sources. As shown in Table 1.2.1-2, most water systems must purchase water from other suppliers.

Table 1.2.1-2. Water Sources of Caldwell County Water Systems (MDNR 2018).

Water System ID	Water Available to Caldwell County (MGD)**	Water Source System	Water Source
Braymer	0.144	Braymer	Groundwater
Breckenridge	0.144	Livingston Co. PWSD #4	Groundwater
Hamilton	0.288	Hamilton Livingston Co. PWSD #4	Hamilton Lake Groundwater
Kingston	0.072	Kingston	Groundwater
Polo	0.075	Ray Co. Consolidated PWSD #2	Groundwater
Caldwell County PWSD #1	0.038	Caldwell County PWSD #1	Groundwater
Caldwell County PWSD #2	*	Hamilton	Hamilton Lake
Caldwell County PWSD #3	0.212	Plattsburg	Smithville Reservoir
Daviess PWSD #2	0.016	Harrison Co. PWSD #2 Livingston #4	Groundwater
Clinton PWSD #3	0.067	Cameron Clinton County PWSD #4 System #1	Cameron Reservoir Smithville Reservoir
Clinton PWSD #4 System 1	0.124	Plattsburg	Smithville Reservoir
Ray PWSD #1	0.002	Excelsior Springs	Groundwater
Ray PWSD #3	0.074	Ray Co. Consolidated PWSD #2	Groundwater
Livingston PWSD #1	0.001	Chillicothe	Groundwater

*Included in Hamilton Water Available
** In a normal water year

As described in the following sections, even the systems that have their own sources have problems with water quality, water quantity during peak water demands, or both.

For example, the cities of Braymer and Kingston treat groundwater from alluvial wells. Caldwell County PWSD #1 treats groundwater from glacial deposits. All three treatment facilities produce hard water that is high in manganese, requiring expensive treatment plant upgrades (CDM and Bartlett & West 2010). These small groundwater systems face an increasing financial burden because of the combined effects of aging infrastructure and stricter treatment requirements (MDNR 2007). Similarly, the City of Polo recently decided to abandon its two alluvial wells

because of treatment difficulties and to buy water from Ray County PWSD #2 (Edwards et al. 2011). The City of Breckenridge abandoned its water treatment plant and began buying water from Livingston County PWSD #4 in 2014.

The water supply dependability is reduced when the water supply system must rely on short- to medium-term contracts (five to 35 years) from multiple water sources. Short- to medium-term contracts allow Caldwell County water systems very limited control over water rates or over the quantity of water available during a drought. For future planning, supply contracts are not guaranteed to be renewed as they expire.

To be dependable, any contracted water supplier must include a long-term commitment to supply water at a reasonable rate for the design time frame. The contracted water supplier must be able to fulfill all water contracts for all systems served by the water source for the design time frame. There are currently no examples of this type of arrangement in water systems that serve Caldwell County. Supply uncertainty is a major concern in Caldwell County because the water systems serving Caldwell County purchase most of their water from other sources.

The lack of long-term water contracts, and therefore lack of control over water rates, contributes to higher water rates in Caldwell County. Higher water rates are also caused in part by the additive effects of the economy of scale and the cost of purchasing water from another system. The small-volume producers require a higher percentage of revenue to produce water, which sets the baseline cost of water. This, coupled with the costs associated with delivery through one or more systems, means that the end users ultimately pay higher water rates than those systems closer to the source. A regional, large-volume producer can provide water at a lower baseline cost than a small-volume producer can. The end user (whether for a large-volume producer or a small-volume producer) is still paying more than those closer to a water source, but the baseline rates are more affordable for the large-volume producer. Research indicates that larger water systems can cut costs from 10 to 50 percent over small water systems (Shih et al. 2006).

Water Shortage During Drought Conditions

The drought of record occurred in the 1950's and Caldwell County experiences dry periods or minor droughts with the typical climatological variations experienced in the Midwest. As documented in Hamilton City Council minutes, dry periods of concern have occurred at least five times in the last 20 years. In 2012, Caldwell County was included in a disaster declaration by the Secretary of Agriculture for drought and excessive heat. As recently as 2018, the City of Hamilton came within six weeks of running out of water (Van Iperen, 2019).

In accordance with MDNR's drinking water regulations, any dependable water supply must be able to provide water during a prolonged, severe drought, which in Missouri is referenced to the drought of record, which is the drought that occurred from 1951 to 1959. A surface raw water supply must have at least 120 days of water remaining at its lowest point when modeled for the drought of record (MDNR 2013). Current water systems that have their own sources are unable to supply sufficient water to meet demand within Caldwell County during a drought comparable to the drought of record. The Missouri Drought Plan (MDNR 2002) lists Caldwell County in Region C, which has "severe surface and groundwater supply drought vulnerability." The vulnerability of the region underscores the need for a long-term reliable water supply for Caldwell County.

For example, Hamilton Lake is a raw water source for almost 25 percent of Caldwell County and has adequate water supply capacity in a normal year. However, it does not have the tributary drainage area or capacity to meet current demand during the drought of record (Edwards et al. 2011). During the relatively short dry period of six to nine months in 2012-2013, the lake was so depleted that only 45 days of raw water were left in the reservoir (Schulte 2014). Hamilton Lake would run dry during an extended drought like the drought of record and has insufficient capacity to maintain Missouri's required minimum 120 days of water storage even during short-duration droughts.

The existing groundwater sources available to Caldwell County are not dependable now or in the foreseeable future. The MDNR drinking water regulations state "In selecting the source of water to be developed, the design engineer must prove that an adequate quantity of water will be available. The proposed groundwater or surface water source must be adequate for future water demands during the design period" (MDNR 2013). MDNR has indicated that wells in Caldwell County are difficult to establish and usually result in low yields. MDNR has also indicated that two communities north of Caldwell County have abandoned their groundwater sources due to reduced capacity in the wells (MDNR Letter, Appendix A). In the last 10 years, Polo has abandoned its groundwater wells in favor of purchasing water. Braymer and Caldwell PWSD #1, two of the remaining groundwater suppliers in Caldwell County, have joined the LOCWWC, indicating their desire to develop and buy from a new surface water source for their future raw water supplies. The continued migration of water systems from groundwater sources to surface water or sources outside the County indicate that groundwater is not a dependable water source in Caldwell County.

Groundwater sources currently provide 0.312 mgd (See Table 1.2.1-4); however, based on the information provided by MDNR, groundwater levels would not be able to sustain this supply during a severe drought. Surface water sources within the County have been shown to be inadequate during a drought less intense than the drought of record. Since neither groundwater nor existing surface water would provide a reliable source of water during a record drought similar to that of the 1950s, the County needs a new water source to provide dependable, long term water supply.

Population and Water Demand Projections

Water demand from a water system increases for a number of reasons, including increased population served, increased industrial and agricultural demand, and switching from rural well water to rural water supply system water. In addition, over time, per capita use has increased for domestic uses as more water-using appliances and more lawn and garden irrigation have become part of American life. Future water demands cannot be met with the existing water supply in Caldwell County.

Water demand is not necessarily correlated to population trends, since water usage can fluctuate because of new or existing businesses or industrial customers. Predicting potential changes in water consumption and demand caused by these and other factors is difficult. In order to determine a reasonable water demand projection for the evaluation, it is assumed that water use will be correlated to population. While this is reasonable for estimating design demand, increasing business or industrial activity can accelerate the rate at which excess raw water source capacity is depleted.

For example, Grindstone Reservoir, completed in 1991, was sized to provide a long-term public water supply to the City of Cameron, Missouri. Six years after the reservoir was completed, the State of Missouri opened the Crossroads Correctional Center in Cameron. This facility, which has capacity for 1,500 inmates, is a major consumer of public water that was not anticipated at the time Grindstone Reservoir was planned.

Although the Little Otter Creek project is intended to provide a water supply for 100 years, best available data projects population growth only about 50 to 60 years from today. Thus, the Proposed Action was sized to meet the demand projection in 2070, and the facility itself will provide this demand for 100 years. This is a conservative projection of population-based demand, but it relies on the best available population data. If the population continues to grow past the 2070 population level, additional water sources would be needed.

Future demand projections can vary greatly, and an MDNR economist calculated projected water demand for three different scenarios in Caldwell County (Upendram 2016), using population growth and water demand projections for the period from 2000 to 2060. The MDNR methodology for calculating growth rates included evaluating data on future births, deaths, and net migration along with an evaluation of historic growth rates to determine future growth rates through 2060. For the purposes of projecting water supply needs in 2070, the average growth rate from 2055 to 2060 was extended through the years 2061 to 2070. The projected range of growth rate for population (and therefore water demand based on population) from 2015 to 2065 is 0.72 percent, 1.72 percent, and 2.72 percent for the low-growth, medium-growth, and high-growth scenarios, respectively.

As an additional point of comparison in developing the reasonable range of population projection to be used in determining design raw water demand, the previous six decades of decennial census data was evaluated. While population was relatively flat from 1960 to 1990, the census population has shown an average increase of 0.59 percent per year from 1990 to 2010. See Figure 1.2.1-1.

The 2003 FEIS recommended growth rate of 1 percent per year is also included in the reasonable design population projections.

The potential range in 2070 population of Caldwell County, along with the reasonable range of growth rates used in analysis, are shown in Table 1.2.1-3.

Table 1.2.1-3. Caldwell County Population Projections.

Year	Census Annual Growth Rate (0.59%)	MDNR Low Growth Rate (0.72%)	FEIS recommended Growth Rate (1.0%)	MDNR Med. Growth Rate (1.72%)	MDNR High Growth Rate (2.72%)
2000*	8,969	8,969	8,969	8,969	8,969
2010*	9,424	9,424	9,424	9,424	9,424
2020	9,995	10,125	10,410	11,176	12,325
2030	10,601	10,878	11,499	13,254	16,119
2040	11,243	11,687	12,702	15,719	21,081
2050	11,924	12,556	14,031	18,642	27,570
2060	12,647	13,490	15,499	22,108	36,057
2070	13,413	14,494	17,121	26,219	47,156

*U.S. Census data (2000, 2010), actual value (not projected).

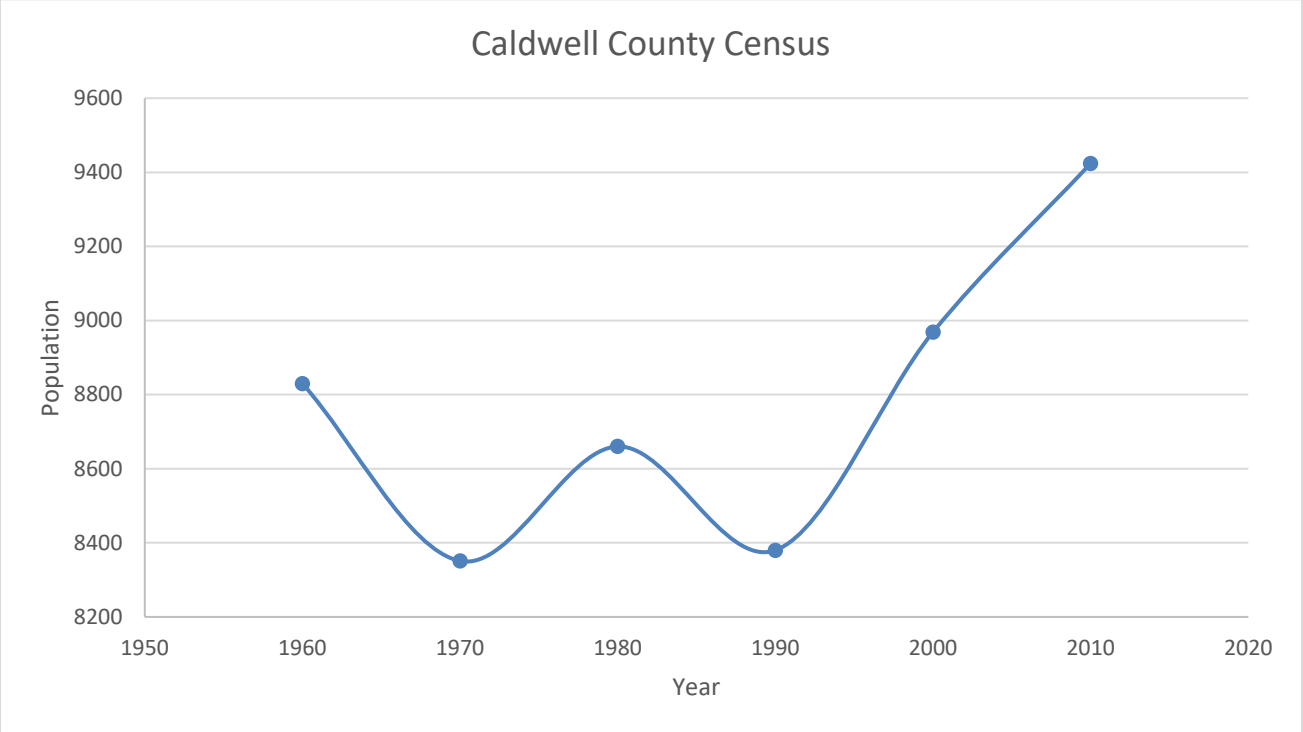


Figure 1.2.1-1. Caldwell County U.S. Census Population, 1960-2010.

Although the population growth rate has been steady over the previous two decades of census data, two relatively recent or upcoming changes could increase the rate of population growth in the county. First, Caldwell County was added to the metropolitan statistical area (MSA) for Kansas City (Missouri and Kansas) in 2003, indicating that Caldwell County has a strong commuting tie

with the Kansas City metropolitan area. The strong commuting tie is defined as at least 25 percent of workers in the county commuting to the Kansas City metropolitan area, or 25 percent of the workers in the county residing in the Kansas City metropolitan area (Federal Register 2010). This indicates that the population in Caldwell County may change from a rural to a more suburban profile in future years as the Kansas City metropolitan area continues to expand. In fact, according to statistical data from the Mid-America Regional Council, counties added to the Kansas City MSA have had an average of 1.2 percent annualized population growth since the individual county's inclusion in the MSA (MARC 2016).

Second, the implementation of a reliable water supply in Caldwell County may increase both the gross population growth and per capita water usage as more industry and development are attracted to the area (MDNR 2007).

Per Capita Water Usage

Water usage on a per capita basis delivered by water systems serving Caldwell County ranges from 40 gallons per capita day (gpcd) to 130 gpcd with a population-weighted average of 78 gpcd based on the 2015-2018 MDNR Census of Missouri Water Systems (MDNR 2015, 2016a, 2017a, 2018). Table 1.2.1-4, below, shows the ranges of per capita water usage values in Caldwell County. Although water usage rates may continue at the current county average, the range in values indicates increased water usage could occur because of a reliable water supply; more use of rural water systems rather than wells or increased urbanization.

Table 1.2.1-4. Caldwell County per Capita Water Usage, 2014-2017 (MDNR 2015, 2016a, 2017a, 2018).

Water System Source	County	2010 Caldwell County Population Served	2017 Caldwell County Share of Demand (MGD)	Caldwell County per Capita Water Usage (gpcd), 2014-2017
Braymer	Caldwell	1,050	0.052	64
Breckenridge	Caldwell	415	0.050	130
Hamilton	Caldwell	1,750	0.21	120
Kingston	Caldwell	382	0.031	87
Polo	Caldwell	586	0.040	70
Caldwell PWSD#1	Caldwell	471	0.024	52
Caldwell PWSD #2	Caldwell	300	0.020	50
Caldwell PWSD #3	Caldwell	1,431	0.086	68
Daviess PWSD #2	Daviess	216	0.011	40
Clinton PWSD #3	Clinton	960	0.045	44
Clinton PWSD #4 System 1	Clinton	800	0.083	81
Ray PWSD #1	Ray	28	0.001	65
Ray PWSD #3	Ray	891	0.049	75
Livingston PWSD #1	Livingston	13	0.0008	58
Totals	**--**	**9,293**	**0.712**	**78***

*Weighted Average by Population Served

The state of Missouri has established minimum design standards for water supply systems to assure compliance with the Missouri Safe Drinking Water Law (SMO 640.115[2]). In the *Minimum Design Standard for Missouri Community Water Systems* (MDNR 2013), the state engineering design requirements for a water system state that average domestic water usage for residential developments should be based on historic usage data representative of the climatic conditions that affect demand and source, if available. As shown in Table 1.2.1-4, per capita usage is 78 gpcd and this number is used for the per capita design demand.

Calculating the Volume of Water needed for a Dependable, Long-Term Water Supply

Based on projected population growth and the State of Missouri minimum design standards for water supply systems, a water supply volume design demand can be calculated that would provide Caldwell County with a long-term, dependable water supply. This design demand is defined as the projected water supply demand in 2070. The project is intended to provide raw water supply for 100 years at the design demand.

The Caldwell County water demand calculations multiply the potential range of minimum per capita day demand flows (including current demand) by the potential range of population in 2070. The results of the potential water demand and growth scenarios indicate the range in water demand for Caldwell County. The *Minimum Design Standard for Missouri Community Water Systems* (MDNR 2013) includes a minimum of 10 percent usage added to the demand to account for water loss and unbilled water. A range of design values for water supply based on three different population projections, including the 10 percent increase, is shown in Table 1.2.1-5.

The projected water supply need does not account for the potential increase in existing demand or allow for future unforeseen circumstances. Some future uncertainties are:

- Changing population growth because of commuting proximity with the Kansas City metropolitan area as indicated by inclusion in the Kansas City MSA
- Potential increased water demand because of increased business usage resulting from a stable water source or urbanization of the population
- Impacts from climate change potentially causing increased drought frequency and intensity

While these considerations should be included in future analyses of water supply needs since actual conditions inform the decision-making and design process, these are not considered in the current analysis.

Table 1.2.1-5. Projected 2070 Design Raw Water Supply Range, million gallons per day (mgd).

Growth Rate	Population Served	Water Demand (mgd)
Census Growth Rate	13,413	1.15
MDNR Low Growth Rate	14,494	1.24
FEIS Growth Rate	17,121	1.47

Note: Raw Water Demand = 1.1 × 78 = 85.8 gpcd (MDNR 2013)

As shown in Table 1.2.1-5, projected demand could range from 1.15 mgd to 1.47 mgd or more, depending on the population growth only and not on an increase in per capita demand or unforeseen contingencies. Considering the potential range in water demand, the critical life supporting nature of water supply, and the lack of other contingency considerations in the calculations, a design water supply need of 1.24 million gallons per day (mgd) was selected as a reasonable design demand value to accommodate the projected need for the project.

Caldwell County's water supply is currently insufficient under drought conditions and incapable of meeting increased demand. Based on the lack of proven dependability in the existing supply and on existing and future demand, Caldwell County needs a new source of raw water that can provide water systems and PWSD serving residents and businesses in the County with at least 1.24 mgd in a dependable long-term water supply.

Changing Climatic Conditions and Extreme Weather Events

In the time since the 2003 FEIS was completed, the United States has become increasingly aware of the impacts that climate change may have on agriculture, industry, and our quality of life. On May 6, 2014, the White House issued a comprehensive, authoritative scientific report on the impacts of current and future climate change on every region of the country. The state report for Missouri cites this language from the overall report:

> "The Midwest's agricultural lands, forests, Great Lakes, industrial activities, and cities are all vulnerable to climate variability and climate change. Climate change will tend to amplify existing risks climate poses to people, ecosystems, and infrastructure. Direct effects will include increased heat stress, **flooding, drought,** and late spring freezes…. Climate change may intensify other stresses on urban dwellers and vegetation, including increased atmospheric pollution, heat island effects, **a highly variable water cycle,** and frequent exposure to new pests and diseases" (Emphasis added; Source: White House 2014).

A recent report (Moody's Investors Service, 2017) highlights the growing awareness of the potential impacts of "climate shocks" on local governments. Moody's Investors Service is the bond rating business of Moody's Corporation. This company provides international financial research on bonds issued by commercial and government entities. Along with Standard & Poor's and Fitch Group, they are considered one of the "Big Three" credit rating agencies. Moody's Investors Service issued a report on November 28, 2017 titled, "Environmental Risks -- Evaluating the impact of climate change on US state and local issuers." The report explains how the company incorporates climate change into its credit ratings for state and local bonds. The increasing frequency and magnitude of climate shocks such as droughts, floods and storms can significantly impact the ability of communities to service their debt if they have not taken steps to mitigate potential impacts. Moody's will consider both exposure and what communities are doing to mitigate the potential impacts of climate shocks when issuing bond ratings. Communities that have not prepared for climate change are a greater credit risk and will pay higher interest rates on bonds than those that are prepared.

The Little Otter Creek project helps protect the communities and citizens of Caldwell County from the threat of extreme weather events by reducing the risks of prolonged drought caused by an inadequate water supply and by reducing flood damages. According to the Missouri state report, mechanisms being used by local governments to prepare for extreme weather events include

completing land-use planning; ensuring provisions to protect infrastructure and ecosystems; enacting regulations related to the design and construction of buildings, roads, and bridges; and preparing for emergency response and recovery. These local adaptation planning actions are unfolding in municipalities of different sizes and regional agencies and regional aggregations of governments are also taking actions. The Little Otter Creek project is a sustainable action that mitigates potential future impacts from extreme weather events for Caldwell County, Missouri.

Water Treatment and Water Transmission and Distribution

Under Council on Environmental Quality (CEQ) NEPA regulations (Section 1508.25(a)(1)), connected actions "are closely related and therefore should be discussed in the same impact statement. Actions are connected if they:

(i) Automatically trigger other actions which may require environmental impact statements.
(ii) Cannot or will not proceed unless other actions are taken previously or simultaneously.
(iii) Are interdependent parts of a larger action and depend on the larger action for their justification."

Use of water from the proposed reservoir to meet future water demand will require transmission, treatment, and distribution of the water. Currently, 14 different water supply systems operate wholly or partially in Caldwell County and serve the county. No distribution system links these 14 systems together. In order to evaluate alternatives that could provide water to all of Caldwell County, the proposed location of a water treatment plant to be built by the LOCWWC to use the raw water provided by the Proposed Action is assumed to be adjacent to an alternative water source within the county, and at the geometric centroid of the County for alternative water sources outside the County.

The water treatment plant and transmission and distribution lines are not proposed as part of the Proposed Action; however, they are considered a connected action for the Little Otter Creek Watershed Plan. Therefore, a conceptual water treatment plant and distribution plan are evaluated as part of the multipurpose alternatives considered in this SEIS.

The transmission of finished water through the new transmission system is anticipated to use existing lines where possible, but a substantial network of water transmission mains will be necessary to distribute water to the existing water systems. The new LOCWWC, which was formed in anticipation of water supply being available from completion of the Little Otter Creek Watershed Plan, will make future and final decisions on how the water supply is treated and distributed.

1.2.2 Water-Based Recreation Need

One purpose of this project is to provide water-based recreation for the unmet demand in Caldwell County. The project's PL 83-566 application from the Caldwell County commission to the USDA in 1990 specifically discussed the recreational component and recreational needs. The following text from the PL 83-566 application discusses this need:

> "This project would make a significant contribution to providing water-based recreation opportunities …. Currently there is no public recreation facility within the

> project area. To enjoy water-based recreation, local residents have to drive 1 hour or more to reach a lake the size of the Proposed Action. In addition to multi-recreational benefits of boating, hunting, fishing, camping, and hiking, the area would be managed for wildlife habitat development."

In addition, in 1991, the MDC identified the need for a public recreation lake in Caldwell County as part of its Public Lakes Program Acquisition and Development Plan (Ryck 1991). A lake in Caldwell County would meet the MDC goal of providing close-to-home fishing opportunities for Missouri residents within the basin (Ryck 1991).

2003 FEIS Recreational Need Analysis. Data from supply and demand for recreational opportunities were used to quantify the need for water-based recreation. Results of the data analysis, incorporated in the 2003 FEIS, were focused on water-based recreation to meet unmet demand for fishing.

The methodology in the 2003 FEIS used a "unit day" method as outlined in the United States Water Resources Council's (1983) Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies. According to page 68 of the Economic and Environmental Principles and Guidelines, the "unit day value method relies on expert or informed opinion and judgment to estimate the average willingness to pay of recreation users" and can be used to estimate use, in terms of user-days (USWRC 1983).

To calculate demand, the recreation market area (RMA) used in the 2003 FEIS was 25 miles from the Proposed Action, which was consistent with the 1990 Missouri Statewide Comprehensive Outdoor Recreation Plan (SCORP-90; MDNR 1991) and the MDC Seven Cities Study (MDC 1990). The RMA of 25 miles of the proposed Little Otter Creek Reservoir site included the entire population of Caldwell County and portions of populations from eight other counties. In addition, the MDC Seven Cities Study found that 58 percent of respondents wanted more fishing, and 39 percent wanted more hunting opportunities within 20 minutes from home (MDC 1990).

According to Page E-7 in the 2003 FEIS, "*A team made up of federal, state, and local representatives determined points for general recreation required by the methodology described. Participation rates were determined using figures generated by the Missouri Statewide Comprehensive Outdoor Recreation Plan. Recreation User-day point values were determined as shown on page 84 of the federal Principles and Guidelines publication*."

The 2003 FEIS determined a fishing demand within the RMA of 230,000 annual user-days, while the total fishing supply within the RMA was only 130,000 annual user-days. Thus, there was an unmet fishing demand of 100,000 annual user-days within the RMA. The analysis concluded that the Little Otter Creek Reservoir would support the unmet fishing demand by supplying an estimated 60,000 annual user-days (NRCS 2003).

The water-based recreational purpose of this project is for fishing and wildlife habitat. The recreational purpose was never intended to provide athletic recreational facilities such as golf, tennis, basketball, soccer, or football. Key additional benefits associated with a lake for water-based recreation could easily be established within the area managed for wildlife habitat; such benefits include camping, wildlife viewing, and bike riding.

Current Recreational Need. No new recreational facilities have been constructed within the RMA since the 2003 FEIS, and population has increased based on the 2010 census. Since no change

in supply has occurred, and there is no evidence that demand has decreased, this SEIS conservatively estimates there is still an unmet demand for an estimated 100,000 annual user-days.

1.2.3 Flood Damage Reduction Need

Little Otter Creek flooding has been studied and documented through the Little Otter Creek Watershed Plan and the FEIS (NRCS 2003). The County-owned land north (upstream) of Northeast Jefferson Drive is not incurring flood damages and is not anticipated to incur flood damages if the Proposed Action is constructed. The flood damage reduction purpose is to reduce flood damages on 3.8 miles of Little Otter Creek between Northeast Jefferson Drive and the confluence with Otter Creek. Flood damages occur to agricultural lands, bridges, and roadways. Much of the area continues to be used for agricultural production by local property owners who continue to depend on the land for their livelihoods, and it is anticipated that existing land use will continue in the future. The areas prone to flooding are predominantly crop and pasture land with roads, bridges and buried utility infrastructure in the area.

Sediment deposition contributes to flooding problems in the downstream portion of Little Otter Creek watershed. According to the 2003 FEIS, soil erosion from the Little Otter Creek watershed is estimated at 28,300 tons annually. Of this, an estimated 13,300 tons is delivered to the mouth of Little Otter Creek (a delivery ratio of 0.47). The remaining 15,000 tons of sediment is redeposited on crop fields and floodplains; in farm ponds and wetlands and in stream channels and gullys. (NRCS 2003).

Large floods that occur less frequently than every 10 years on average (less than a 10% probability of occurrence in a given year) cause floodwaters to spill over the banks of the creek and into the Little Otter Creek floodplain. A 100-year flood event (1% probability of occurrence in a given year) floods 312 acres along Little Otter Creek.

Average annual flood damages were calculated using the NRCS ECON2 model (USDA 1990). ECON2 determines damages for various stream reaches from several known points of data. It uses several types of information, including commodity prices, crop distributions, water elevations where damages begin, and elevation and areas affected for specific storm event flows based upon the modeling of stream flood flows. Flood flows were computed using the Hydrologic Engineering Center's Hydrologic Modeling System (HEC-HMS) model. The flood flows from the HEC-HMS model were entered into the River Analysis System (HEC-RAS) hydraulic model of Little Otter Creek from the outlet of the proposed dam to the mouth at the confluence with the main stem of Otter Creek. It then examined flows for different frequencies of storm events.

ECON2 calculates bridge damages using a damage curve for each bridge. The damage curve tells ECON2 how much damage occurs at various water surface elevations. It then analyzes the flows for each of the flood events, from frequent events to the 100-year event, to calculate the average annual damages. Based on the ECON2 model, average annual damages to crops and infrastructure are estimated to be the following:

- $86,000 in damages to crop and pastures, including fences and debris
- $21,000 in damages to roads and bridges

The total estimated average annual damages from flooding is $107,000. Figure 1.2.3-1 depicts the estimated annualized damages along stream reaches through the study area. Flooding has resulted in a substantial cost to the county government and to local property owners who depend on the land for their livelihoods.

In 2015, the Federal Emergency Management Agency (FEMA) further validated findings in the Little Otter Creek watershed by issuing a Flood Insurance Rate Map (FIRM). The FIRM depicts Little Otter Creek as being a “special flood hazard area subject to inundation by the 1 percent annual chance flood event” (FEMA 2015a).

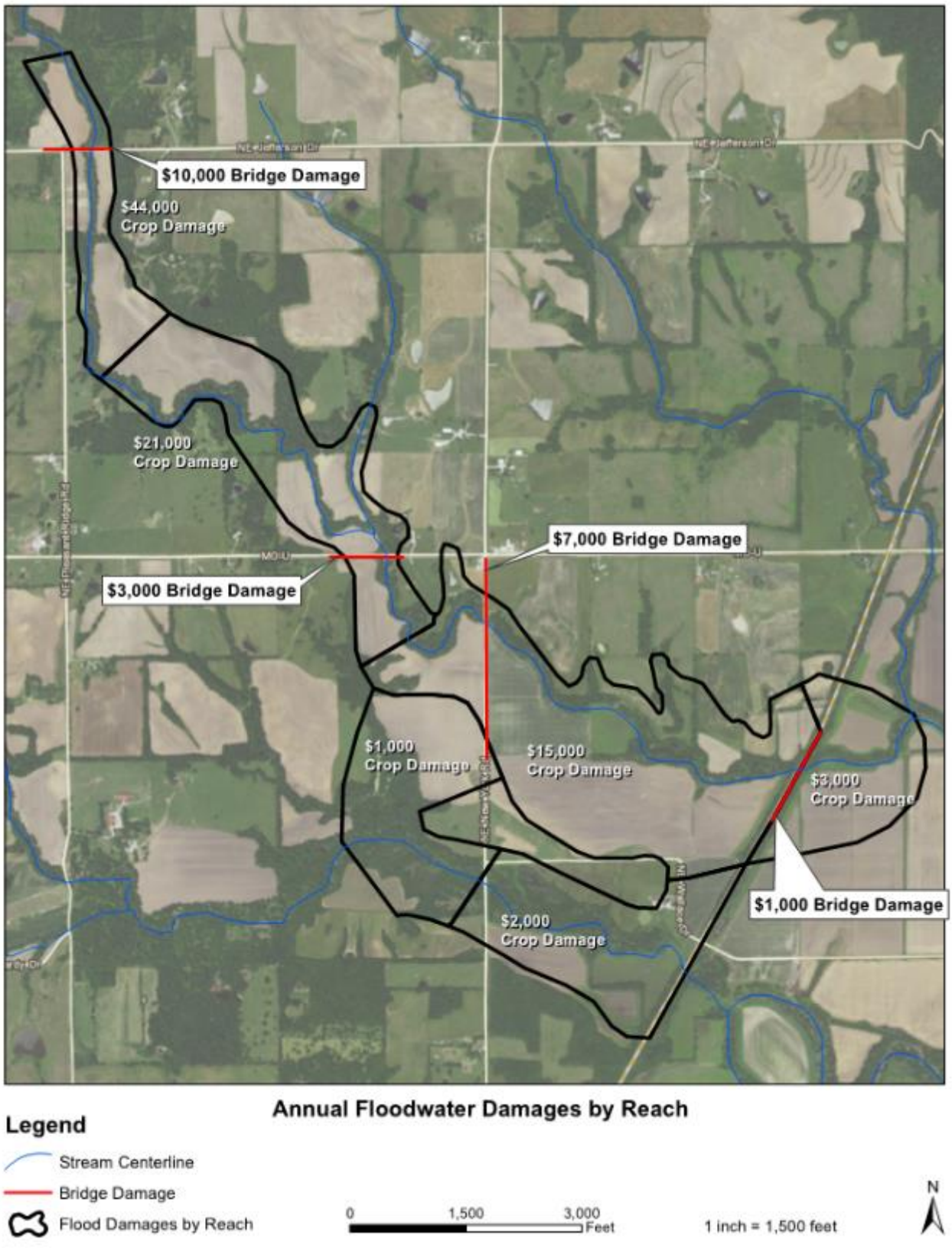


Figure 1.2.3-1. Annual Floodwater Damages by Reach (from ECON2 results).

1.3 Authority

This document was prepared under authority of the Watershed Protection and Flood Prevention Act, PL 83–566 (16 U.S.C. 1001–1008), and in accordance with Section 102(2)(c) of NEPA of 1969 as amended (42 U.S.C. 4321 et seq.). Responsibility for complying with NEPA rests with the NRCS. Evaluation of a Section 404 permit application under the CWA (40 Code of Federal Regulations [CFR] 230) for impacts to jurisdictional waters rests with the USACE and the USEPA.

1.4 Decisions to be Made on this Analysis

This SEIS document updates the 2003 FEIS and provides information to comply with the USACE 404(b)(1) guidelines. The updates focus on information that has changed since 2003 and is not meant to duplicate information provided in the 2003 FEIS. Readers should reference the 2003 FEIS document as the primary document and use this SEIS to supplement the FEIS.

Both the NEPA requirements and the 404(b)(1) guidelines require the establishment of a purpose and need and the review of a reasonable range of alternatives, with the goal of identifying a preferred alternative. This SEIS document focuses on the purpose and need and alternatives analysis to update the 2003 FEIS and on a review of impacts of alternatives on social, economic, and natural environmental resources. The 404(b)(1) guidelines primarily evaluate impacts to aquatic resources and only secondarily consider other resources in a public interest evaluation. The alternatives analysis is developed in this SEIS to provide information to meet both 404(b)(1) guidelines and support a USACE Section 404 permit application. Figure 1.4-1 shows overlapping and divergent paths of the NEPA requirements and 404(b)(1) guidelines.

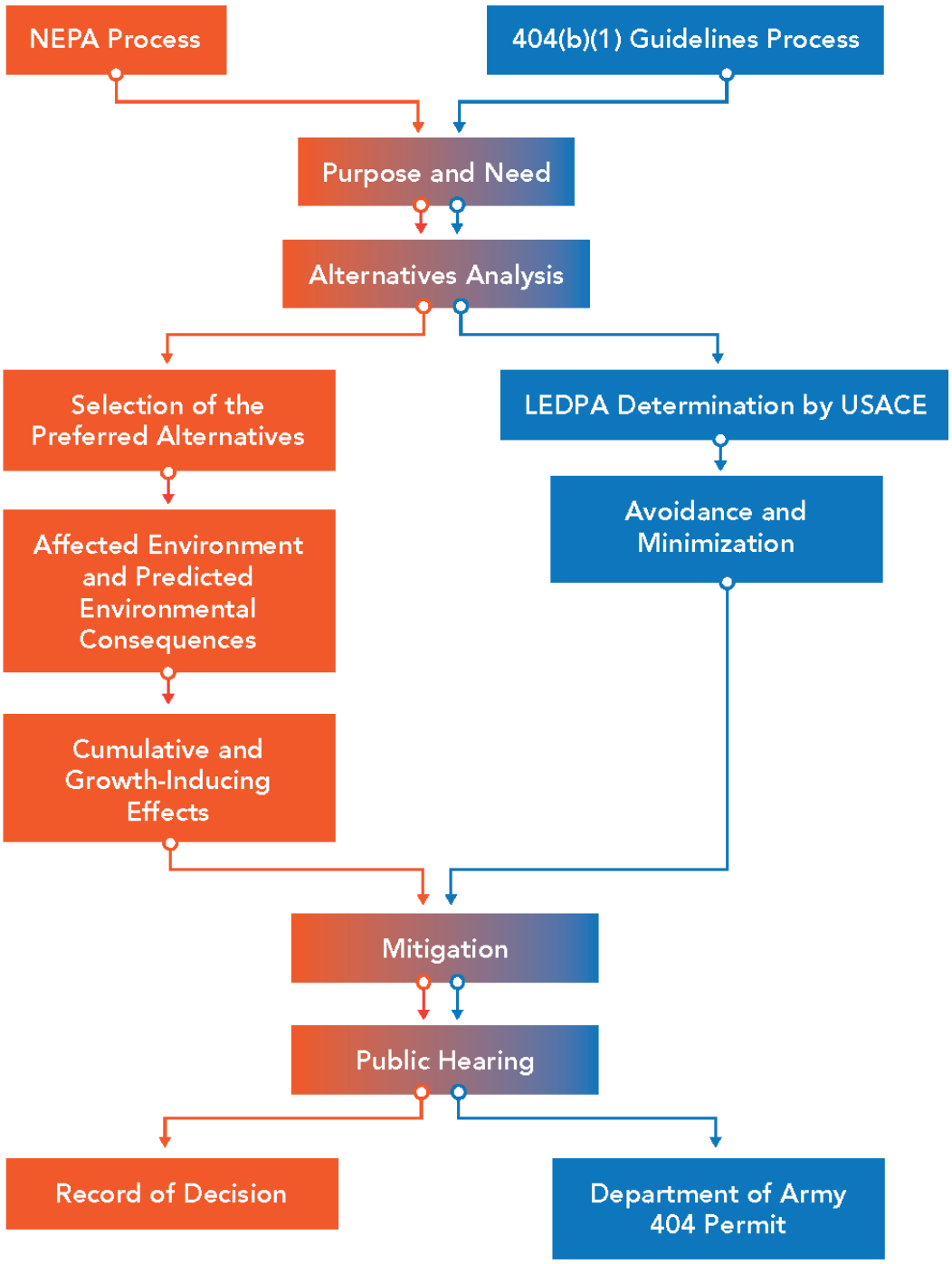


Figure 1.4-1. Comparison of NEPA and 404(b)(1) Guideline Processes.

1.5 Environmental Issues Addressed

This SEIS addresses changes that have occurred since the original FEIS was completed in 2003. National Environmental Policy Act (NEPA), Endangered Species Act (ESA) and CWA Section 404(b)(1) guidelines drive the analyses presented in this document. The environmental alternatives analyses in this SEIS focus primarily on impacts to threatened and endangered species and aquatic resources.

1.0 Introduction and Purpose and Need

2.0 Alternatives Analysis

3.0 Affected Environment and Predicted Environmental Consequences

4.0 Cumulative and Growth-Inducing Effects

5.0 Comparison of Alternatives and Mitigation

6.0 Compliance and Consultation with Applicable Laws, Policies, and Plans

7.0 Public Involvement

8.0 List of Preparers

9.0 Distribution List

10.0 Reference

2.0 Alternatives Analysis

The alternatives analysis is intended to meet both the requirements of NEPA and of the CWA Section 404(b)(1) guidelines. Both require that a reasonable range of alternatives be considered. The NEPA alternatives analysis focuses on screening alternatives to determine that they are reasonable. The Section 404(b)(1) analysis focuses on practicable alternatives. The alternatives discussed were developed jointly with the regulatory agencies to satisfy both NEPA and Section 404(b)(1) requirements.

Multipurpose Project

This project has three purposes: water supply, water-based recreation, and flood damage reduction. Each project purpose is equally weighted. This SEIS document screens alternatives to determine if they meet each project purpose individually. Alternatives that meet one or two but not all three purposes are combined with another alternative(s) to develop a multipurpose alternative that meets all three project purposes.

With the goal of identifying alternatives that would satisfy both the NEPA and the Section 404(b)(1) requirements, a list of alternatives was developed by the project proponent and agreed upon by the interagency review team and NRCS. The alternatives presented in the individual purpose sections do not necessarily meet all three project purposes and may require combination with other alternatives to meet the multiple purposes required for this project. Alternatives that provide more than one of the project purposes will be described the same way in each individual purpose section.

Each individual purpose section screens alternatives for a specific project purpose. Screening of alternatives regarding preliminary impact analysis occurs in the multipurpose alternatives analysis section where the alternatives that meet all three project purposes are compared for impacts. The USACE will consider the alternatives analysis in their determination of the multipurpose LEDPA.

Screening Criteria

Each of the three project purposes includes the development of alternatives and screening criteria that allow the project proponent to meet the purpose and need for each individual project purpose. An alternative is eliminated from consideration if it does not meet an individual project purpose or if it cannot be combined with another alternative to meet an individual project purpose as determined by the screening criteria. Thresholds within the screening criteria are intended to allow for the analysis a wide range of reasonable alternatives while eliminating alternatives that fail to meet the project purposes and needs. A reasonable range of alternatives allows a more detailed evaluation of a smaller number of alternatives that meet all the project purposes and needs.

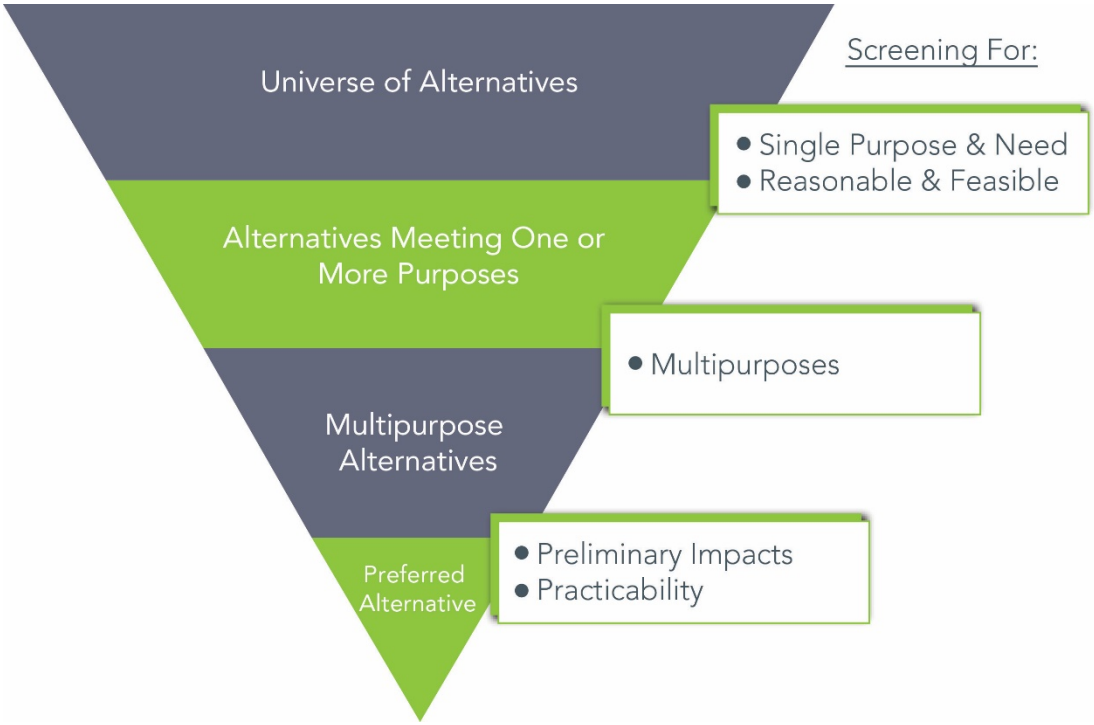
Combination of Alternatives

Alternatives will be combined within the individual purposes sections and within the multipurpose section. Within the individual purposes section, an alternative will be combined with another alternative when the alternative does not individually meet the screening criteria. Alternatives that individually meet the screening criteria also meet the project purpose and are considered in the multipurpose analysis section.

Within the multipurpose analysis section, alternatives that have met screening criteria for at least one individual purpose, but that do not meet all three project purposes, will be combined to create

a combination alternative that meets all three purposes. Combined alternatives for both the individual purposes and for the multipurpose analysis that have the fewest wetland, stream, or forest impacts, are carried forward for the final alternatives analysis.

The alternatives screening process can be a little complicated and lengthy, so in this chapter this "directory" will indicate where the reader is in the screening process.



Evaluation of Alternative Impacts

Alternatives that were carried forward from the initial screenings for purpose and need were analyzed to meet 404(b)(1) guidelines, which also required consideration of endangered and threatened species.

Detailed studies and analysis of impacts have been completed for the Proposed Action and are presented in Sections 3, 4, and 5 of the SEIS; however, for consistency in comparing all alternatives, the following databases were used to determine wetland, stream, and forest impacts for all alternatives:

- Wetland impacts were based on the NWI data.
- Stream impacts were based on NHD.
- Forest impacts were based on the National Land Cover Database (NLCD). This resource was included in the evaluation criteria as a possible indication of impacts to the habitat of threatened or endangered species. A detailed bat study has been completed for the Proposed Action, and a summary of the study results is included in Section 3.

Alternative Cost Development

Installation cost could also be a consideration and is included in the multipurpose alternatives analysis section for potential evaluation for practicability of an alternative. Installation costs are based on known installation costs for similar projects in Northern Missouri, and include costs associated with design, construction, land acquisition, and mitigation for the project. The installation cost description is included in Appendix B.

Alternative Naming Convention

Some of the alternatives are described in only one project purpose section, whereas others are found in more than one. To be consistent in naming them in different sections, alternatives were named based on the number of project purposes the alternative could provide and the individual purpose the alternative could provide.

The list below describes how different alternatives are named, and how they are evaluated in the alternatives analysis.

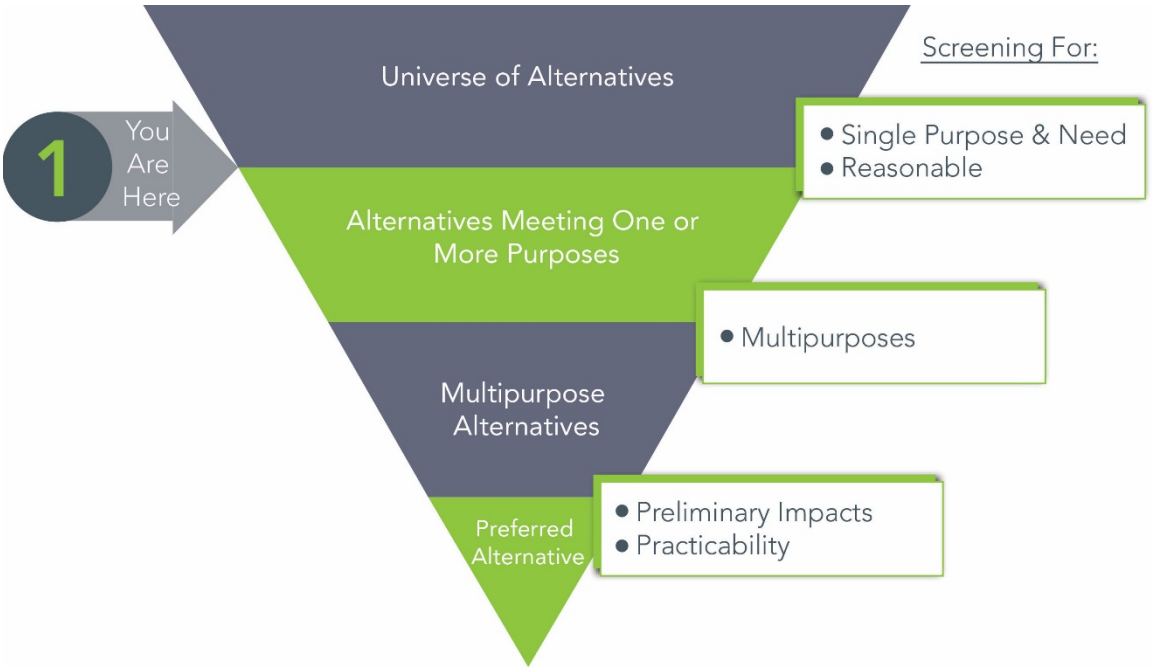
- **Alternatives providing all three purposes are named MA# for Multipurpose Alternative.** These alternatives provide all three of the project purposes of water supply, flood damage reduction, and water-based recreation opportunities. Multipurpose alternatives do not need to be combined with other alternatives.
- **Alternatives providing two project purposes are named DPA# for Dual Purpose Alternative.** An alternative that provides two of the project purposes would need to be combined with an alternative providing the third purpose to create a multipurpose alternative, and it would not be combined with an alternative for the two purposes already met.
- **Alternatives providing one project purpose are named WA# for Water Supply, RA# for Water-Based Recreation, or FA# for Flood Damage Reduction Alternatives.** An alternative that could provide one of the project purposes would need to be combined with one or more alternatives providing the remaining two purposes to create a multipurpose

alternative, and it would not be combined with an alternative(s) for the purpose already met.

- **No Action Alternative.** Although this alternative does not meet any of the project purposes, it is carried forward as a baseline comparison, as is required by NEPA.

2.1 Water Supply Alternatives Development

The list of water supply alternatives was developed after defining the water supply project purpose, which is stated on page 4 of the FEIS as, "To provide an adequate, dependable, locally controlled water supply system for the rural areas and municipalities within Caldwell County." For the SEIS, the water supply project purpose is stated as this: "Provide a dependable long-term water supply to meet a projected 50-year demand for Caldwell County municipalities and residents." The selected alternative would have a design life of 100 years at the design demand.



This section screens the universe of alternatives for water supply.

The alternatives developed include some within and some outside of the county. Table 2.1-1 provides the list of alternatives to be considered.

Table 2.1-1. Water Supply Alternatives Considered.

	No Action Alternative
Groundwater Sources	
WA1	Deep Aquifer Groundwater Sources in Caldwell County
WA2	Shallow Alluvial Groundwater Sources in Caldwell County
Connecting to an Existing Systems	
WA3	Great Northwest Wholesale Water Commission or some other source at Cameron
WA4	City of Chillicothe Water Supply
WA5	City of Plattsburg Water Supply
Streams and Rivers	
WA6	Missouri River
WA7	Shoal Creek Pipeline and Offline Storage
Existing Lakes	
WA8	Hamilton Lake
WA9	Breckenridge Lake
WA10	Hamilton Lake Modification
WA11	Breckenridge Lake Modification
Creation of a New Reservoir	
WA12	Creation of an Offline Channel Reservoir
MA1	Little Otter Creek Reservoir – Proposed Action
DPA1	Alternative Reservoir Location – Site 2
DPA2	Alternative Reservoir Location – Site 3
DPA3	Alternative Reservoir Location – Site 4
DPA4	Alternative Reservoir Location – Site 5
Combination of Alternatives	
DPA5	Combination of DPA1 and DPA2
WA13	Combination of WA7, WA10, and WA11

*WA = Water Supply Alternative; MA = Multipurpose Alternative; DPA = Dual Purpose Alternative

For consistency in comparing all alternatives on an equal basis, environmental impacts to streams, wetlands, and forest areas in this chapter were calculated from publicly available NHD, NWI, and NLCD data. The remainder of the document uses more precise data where available.

Calculating the Impacts and Cost of Finished Water

The Caldwell County Commission, which is the project sponsor, does not have the statutory authority to sell wholesale water. The LOCWWC was formed in 2016 with the authority to sell wholesale water. The LOCWWC is a separate governmental entity that was established to provide for the funding, financing, construction, acquisition, and operation of a wholesale water system, including but not limited to a water treatment plant, distribution system, and supply contract for water supply source in Caldwell County, Missouri (LOCWWC 2016). The LOCWWC will make future and final decisions on how the water supply is treated and distributed.

To compare installation costs, opinions of probable cost for alternatives that meet the screening criteria included either (1) an expanded water treatment facility cost that covers the installation cost for the infrastructure and equipment required to produce finished water; or (2) the installation cost of "purchasing" capacity from existing facilities. Alternatives that do not meet the screening criteria do not include opinions of probable cost. The installation costs for the water treatment facilities are included in the cost breakdowns for each alternative in Appendix B. The installation costs of alternatives does not include the cost for a system to distribute finished water because all alternatives are presumed to require the same distribution system.

Impacts of Conceptual Treatment and Distribution System

The following assumptions were made for determining the conceptual water treatment plant location and distribution system layout:

- The conceptual water treatment plant location is assumed to be adjacent to an alternative water source within the county, and at the geometric centroid of the County for alternative water sources originating outside the County. The treatment plant would be sited on high ground outside of existing streams and wetlands. Based on best available data, the treatment plant located at the geometric centroid provides the most flexibility in future distribution phasing for a source outside of the County. The exact location of the treatment plant would be based on data developed during a final design study.
- If raw water is provided, then the water would either be treated on-site or transferred to the conceptual water treatment plant.
- Likely paths for the distribution lines were based on the most direct route along existing roads and highways. However, the final path for the selected alternative could change after additional study.
- The transfer of finished water through the new distribution system is anticipated to use existing lines where possible and would be the same for each alternative.

Figure 2.1-1 shows the conceptual distribution system to compare alternatives. Aquatic resources and habitat impacts associated with the distribution lines are estimated as the following:

- 2.5 acres of permanent wetland impacts
- 27.8 acres of permanent upland forest impacts
- 13,330 linear feet of temporary stream impacts
- 3.5 acres of temporary wetland impacts

The plan layout of the distribution system is based on best available data for potential future connection points for existing retail water systems. While the layout is similar for all alternatives, the pipe sizing will generally be between 6"-12", with the large sizes nearer to the treatment plant location. The environmental impacts of trenching and construction are similar for all sizes of pipe being considered. Note that the permanent wetland impacts above (2.5 acres) are based on the amount of palustrine forested (PFO) wetlands affected, since other types of wetlands would revert to their previous vegetation after construction, but forested areas would be kept clear for access.

The areas of disturbance would be restored to preconstruction conditions to the extent practicable following the completion of the project. Construction of the conceptual distribution plan would potentially result in impacts to roads and utilities, depending on final location of the distribution

lines. Impacts to or relocation of utilities would occur in coordination with the local utilities. Impacts to county roads and state highways would occur in coordination with the county and with the Missouri Department of Transportation (MoDOT).

To provide a consistent basis for comparing the environmental impacts associated with the treatment and distribution system, the location of the water treatment plant is as indicated above. Distribution of treated water from the water treatment plant to the municipalities of Caldwell County is also considered the same for each alternative. Transmission of raw water to the treatment plant would vary with each alternative location as described below.

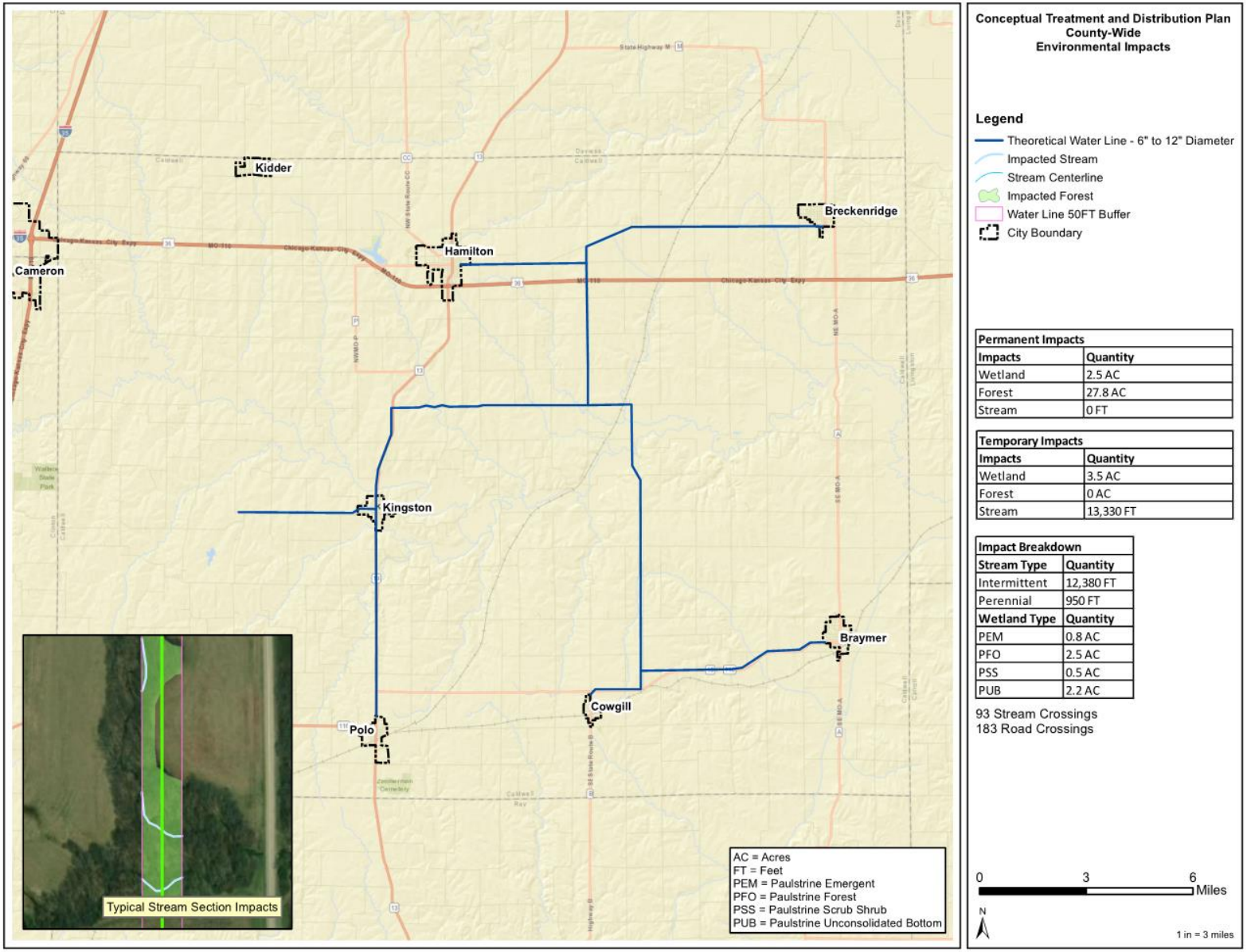


Figure 2.1-1. Conceptual Treatment and Distribution System.

2.1.1 Water Supply Alternatives Screening Criteria

Each alternative was screened for its ability to meet the water supply purpose and need by the criteria in the following list. Alternatives that meet these criteria either alone or in combination with other alternatives were then evaluated to estimate the environmental impacts of each. The results of these evaluations were used to carry alternatives forward for further analysis.

A. Alternatives must reliably provide 1.24 mgd of water during a drought equivalent to the drought of record in the 1950s to a centrally located site in Caldwell County near Hamilton, Missouri.
B. Alternatives must comply with existing state and federal codes and regulations and as promulgated by MDNR, USEPA, and other agencies that may have jurisdiction over all or portions of the water supply infrastructure.
C. Alternatives must provide raw or finished water of a quality that can be brought to current and future drinking water standards using treatment methods that are reasonable and typical for the region.
D. Alternatives must provide a water supply through willing participation of potential suppliers.

2.1.2 Water Supply Alternatives Considered

No Action

Under this alternative, a new water supply reservoir would not be constructed. Existing water suppliers would be unable to meet the current projected future water needs. Consequently, current water utilities would do nothing because implementation of non-regional solutions is cost prohibitive. Water shortages during drought conditions would continue.

If no project is built, the citizens of Caldwell County would continue to be threatened by frequent drought. In 2012, the Hamilton City Council's meeting minutes indicated the drought caused Stage III water restrictions for the City of Hamilton. Stage III water restrictions include a 30 percent reduction in water usage by local businesses, elimination of water sold to livestock producers, closure of the city pool, and prohibitions on watering yards and washing vehicles. As recently as 2018, the City of Hamilton came within six weeks of running out of water (Van Iperen, 2019).

The No Action alternative does not provide any additional drinking water supply to help the region to survive such droughts and, therefore, does not meet the screening criteria for the project. This alternative is carried forward as a baseline for comparison.

2.1.2.1 Groundwater Sources

These alternatives consider potential groundwater sources in the region. Groundwater sources in Caldwell County are very limited. Included in Appendix A in this report is a 2012 letter from Scott Kaden, MDNR's groundwater section chief (MDNR 2012). This letter describes the groundwater challenges in Caldwell County and concludes that there is "*a very high likelihood that increased groundwater production is not a viable option to supply the estimated 1.24 mgd that will be needed in the future for Caldwell County.*" One MDNR report (1997) notes that, in Caldwell County, there are no areas with over 10 feet of clean glacial drift sands. Despite these limits, several groundwater alternatives were investigated.

Deep Aquifer Groundwater Sources in Caldwell County (WA1)

Pennsylvanian-age bedrock composed of limestone, sandstone, shale, and coal underlies the county. Pennsylvanian bedrock has poor vertical and horizontal permeability, which results in very poor aquifer recharge (MDNR 1997). The dissolved solids content of bedrock wells deeper than 200–300 feet ranges from 2,000 to more than 20,000 milligrams per liter (Gann et al.1973). The National Secondary Drinking Water Regulations (40 CFR 143.3) limit total dissolved solids to 500 milligrams per liter for reasons of taste, color, odor, staining, and cosmetic effects. Water in deeper bedrock aquifers is high in sulfate, chloride, and total dissolved solids and results in mineral content not suitable for use (Gann et al. 1973). Because of its low water quality and poor recharge, Pennsylvanian rock is not considered a viable source of groundwater (MDNR 1997).

Based on information presented from MDNR (1997) and Gann et al. (1973), deep aquifer sources in and around Caldwell County cannot produce adequate quantity or quality of water, so this alternative does not meet screening criterion A or C. This alternative is eliminated from further consideration. Since no suitable water yield could be established, this alternative is not considered in the multipurpose analysis or in water supply combination of alternatives.

Shallow Alluvial Groundwater Sources in Caldwell County (WA2)

The principal sources of groundwater currently used for drinking water in Caldwell County include alluvial deposits in the Shoal Creek valley and glacial outwash deposits in buried bedrock valleys. Groundwater sources in Caldwell County currently have a supply capacity of 0.254 mgd at wells shown in Figure 2.1.2.1-1 (MDNR 2014a). According to the MDNR (2012), the maximum reported yield for some of these wells is 150 gallons per minute (gpm), or 0.22 mgd; however, 50 gpm (0.07 mgd) is more common. MDNR (2012) concluded that “Based on the highly variable nature of the deposition of clean sediments and the amount of production that may be obtained from them, one cannot estimate the likelihood of being able to produce 1.24 mgd county wide.”

MDNR (2012) goes on to quote the example of the City of Polo in Caldwell County where it was necessary to drill at least 10 test holes to find two wells with a combined capacity of 225 gpm (0.32 mgd). Highlighting the concern of long-term viability of such wells, MDNR (2012) cites a case just north of Caldwell County where communities have ceased using groundwater because of the lowering of the water level in the alluvial aquifer. The Northwest Missouri Planning Assistance to States Phase 1 Study (MDNR 2007) determined that “shallow gravel walled wells in the alluvial deposits of small streams, glacial deposits and pre-glacial channels and valleys would not provide an adequate volume of water required for a regional water system.” Caldwell County has less than 10 feet of clean glacial drift sands (MDNR 1997). The shallow depth minimizes the possible yield and makes the wells susceptible to periods of reduced water to no water yield during drought.

This alternative is currently producing 0.254 mgd; however, based on the information provided by MDNR, groundwater levels would not be able to sustain this supply during a severe drought. Wells in or near Caldwell County cannot reliably produce significant quantities of water, so this alternative does not meet screening criterion A and is eliminated as a stand-alone alternative. Since this alternative would not provide a reliable source of water during a record drought similar to that of the 1950s, this alternative will not be considered in the multipurpose analysis or in the water supply combination of alternatives.

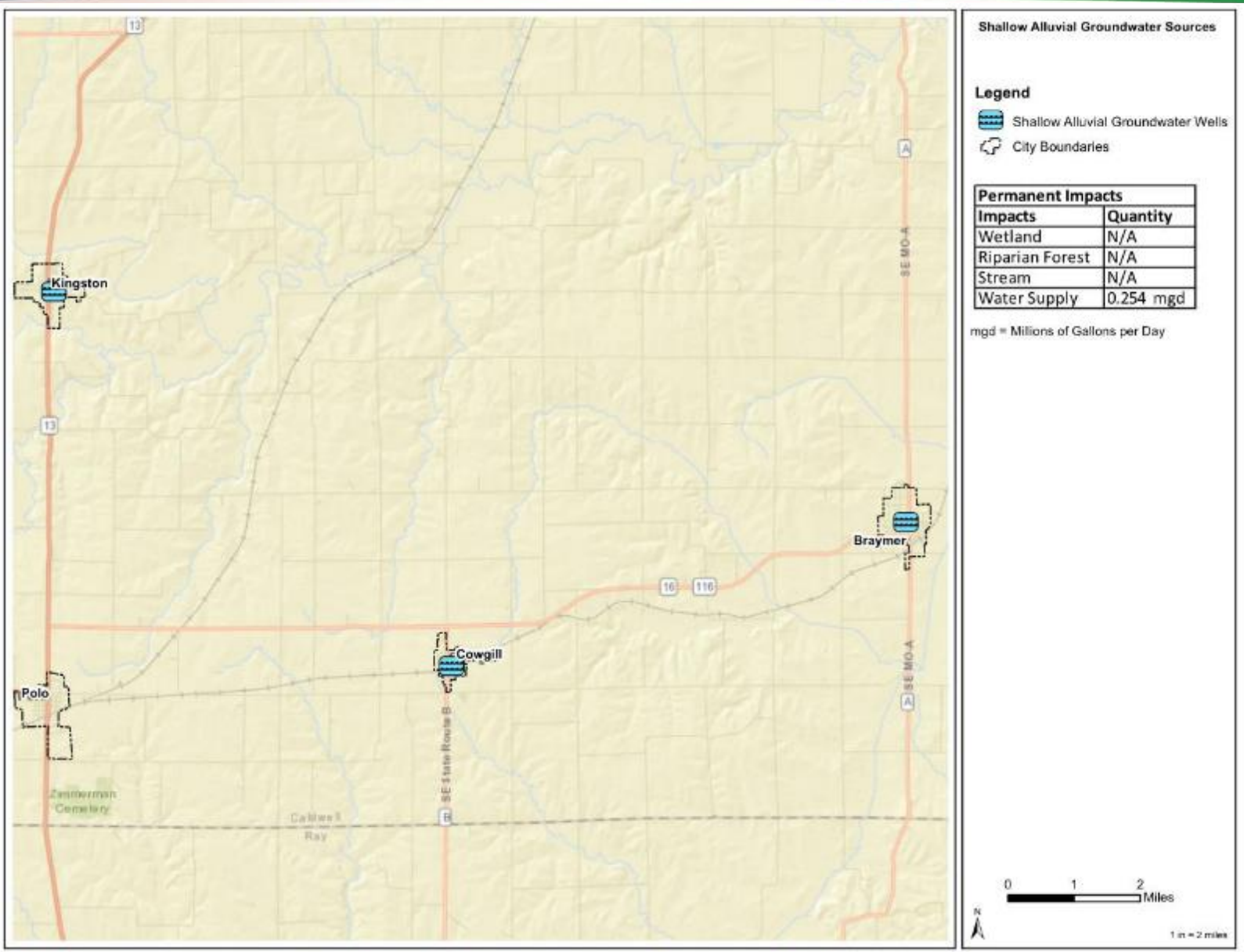


Figure 2.1.2.1-1. Shallow Alluvial Groundwater Sources (WA2).

2.1.2.2 Connection to an Existing System

By evaluating the existing systems outside of Caldwell County, three systems were identified that could potentially provide the 1.24 mgd water supply. These systems include Cameron, Chillicothe, and Plattsburg. These water systems are in adjacent counties and are the nearest water systems with excess capacity for review considerations (MDNR 2014a).

Great Northwest Wholesale Water Commission or some other source at Cameron (WA3)

The City of Cameron, which is located at the eastern edge of Clinton County, is the nearest large municipality to Caldwell County. The City of Cameron has a system comprised of four lakes that provide adequate supply during periods of normal rainfall, but it does not have the capacity to meet the city's need during an extended drought similar to the drought of record in the 1950s (Edwards et al. 2011).

In 2015, the Great Northwest Wholesale Water Commission decided to move ahead with designing and constructing 36 miles of water transmission line with related water storage and pumping facilities from St. Joseph to the cities of Cameron, Maysville, and Stewartsville.

The improvements to be implemented are described in the 2013 Cameron Pipeline Preliminary Engineering Report (PER; USACE 2013). In that report, three "water demand scenarios" were evaluated for pipeline sizing, cost opinions, and the cost of water purchase.

The PER report states, "These scenarios all utilized 2050 maximum day water demands to size the transmission systems…" Based on this statement, it cannot be assumed that the transmission line to Cameron, Maysville and Stewartsville would provide any "excess" water that would be available for Caldwell County to purchase. Also, based on the cost estimate provided in the report and the loan amount, it is presumed that the base scenario was selected for implementation. The base scenario provides the maximum day demand to Maysville but only half of the maximum day demand to Stewartsville and Cameron.

This alternative does not meet screening criterion A or D. It is eliminated from further consideration. Since no reliable water supply could be established, this alternative is not considered in the multipurpose analysis or in the water supply combination of alternatives.

City of Chillicothe Water Supply (WA4)

According to the 2014 Water Census (MDNR 2014a), the Chillicothe water supply is producing and selling 2 mgd, but currently has the capacity to produce 4.5 mgd. Its source is shallow wells in the Grand River alluvium, which is considered a reasonably drought-proof source.

Connection to the Chillicothe water supply would involve pumping water uphill over 29 miles. This is estimated to require two booster stations, 70 road crossings, and 65 streams crossings, including the Grand River. Many of the road crossings would require directional boring, and most of the stream crossings would require encasing the water line. The well and pump stations would also require construction of additional access roads and supporting infrastructure.

The City of Chillicothe was contacted about the prospects of selling water to Caldwell County. According to the City of Chillicothe, they are not able to guarantee a reliable source of water during a period of drought or water shortage because Chillicothe customers and current water districts would take precedence during a water shortage (City of Chillicothe Letter – Appendix A).

Chillicothe's water supply was secured to provide a stable water supply to Chillicothe with anticipation of future growth. Selling water to Caldwell County would require a new water source for the City of Chillicothe in the future.

Since the City of Chillicothe cannot assure a reliable water supply during drought, this alternative cannot produce a reliable water yield that meets criterion A. In addition, because the City of Chillicothe will not agree to sell water to Caldwell County in drought conditions, this alternative does not meet criterion D and is eliminated as a stand-alone alternative. Since the City of Chillicothe cannot supply a reliable source of water, this alternative is not considered in the multipurpose analysis or in the water supply combination of alternatives.

City of Plattsburg Water Supply (WA5)

The 2014 Water Census (MDNR 2014a) indicates that the City of Plattsburg does not currently have excess water because of limitations on its water treatment plant capacity. Plattsburg's raw water supply is the Smithville Reservoir, and according to the 2013 Cameron Pipeline PER (USACE 2013), the city is allotted up to 10 mgd out of Smithville Reservoir. A connection to this water at Plattsburg would require an estimated 32 miles of pipe (Figure 2.1.2.2-1) and extensive treatment plant upgrades or construction of a new plant. The Cameron PER also took purchasing water from Plattsburg into consideration but found that the cost of constructing an expansion to the Plattsburg water treatment plant would be prohibitive (USACE 2013). This alternative would include pumping raw water from Plattsburg to a new treatment plant in Caldwell County.

Pumping water from Plattsburg to Caldwell County is expected to require an estimated three booster stations, an estimated 124 road crossings, and an estimated 103 stream crossings. Many of the road crossings would require directional boring, and most of the stream crossings would require encasing the water line. The wells and pump stations would also require construction of additional access roads and supporting infrastructure.

It is likely that the pump stations could be located so they would have minimal impacts on wetlands, streams, and forests, but access roads to them and the 32-mile-long water line could not be designed to avoid such impacts. This line would generally be aligned adjacent to existing roads for ease of construction and to minimize impacts on previously undisturbed areas, but some impacts are inevitable. Impacts to or relocation of utilities would occur in coordination with the local utilities. Impacts to county roads and state highways would occur in coordination with the county and with MoDOT.

The transmission line is estimated to affect 103 stream crossings and 14,790 feet of stream. Directional boring would be completed at an estimated 11 major stream crossings, which would reduce stream impacts by an estimated 100 feet per crossing. This would result in a reduction of 1,100 feet of stream impacts. The remaining 92 stream crossings would result in an estimated 13,690 feet of stream impacts. However, these impacts would be temporary since stream conditions would be restored to preconstruction conditions once the project is completed. Temporary stream impacts would include an open trench and backfill to previous elevations and contours. Based on the NWI, an estimated 2.9 acres of permanent wetland impacts would occur. Permanent impacts are based on forested (mapped as PFO) wetlands, since those wetlands would need to be permanently cleared over the water line easement. Temporary wetland impacts include an estimated 6.0 acres. Based on the NLCD, upland forest impacts are estimated to be

29.8 acres. Impacts to forest would be permanent since trees would be removed during construction, and the pipeline alignment would be kept clear of trees. This alternative can produce a reliable water yield, meets the selection criteria, and is included in the multipurpose analysis.

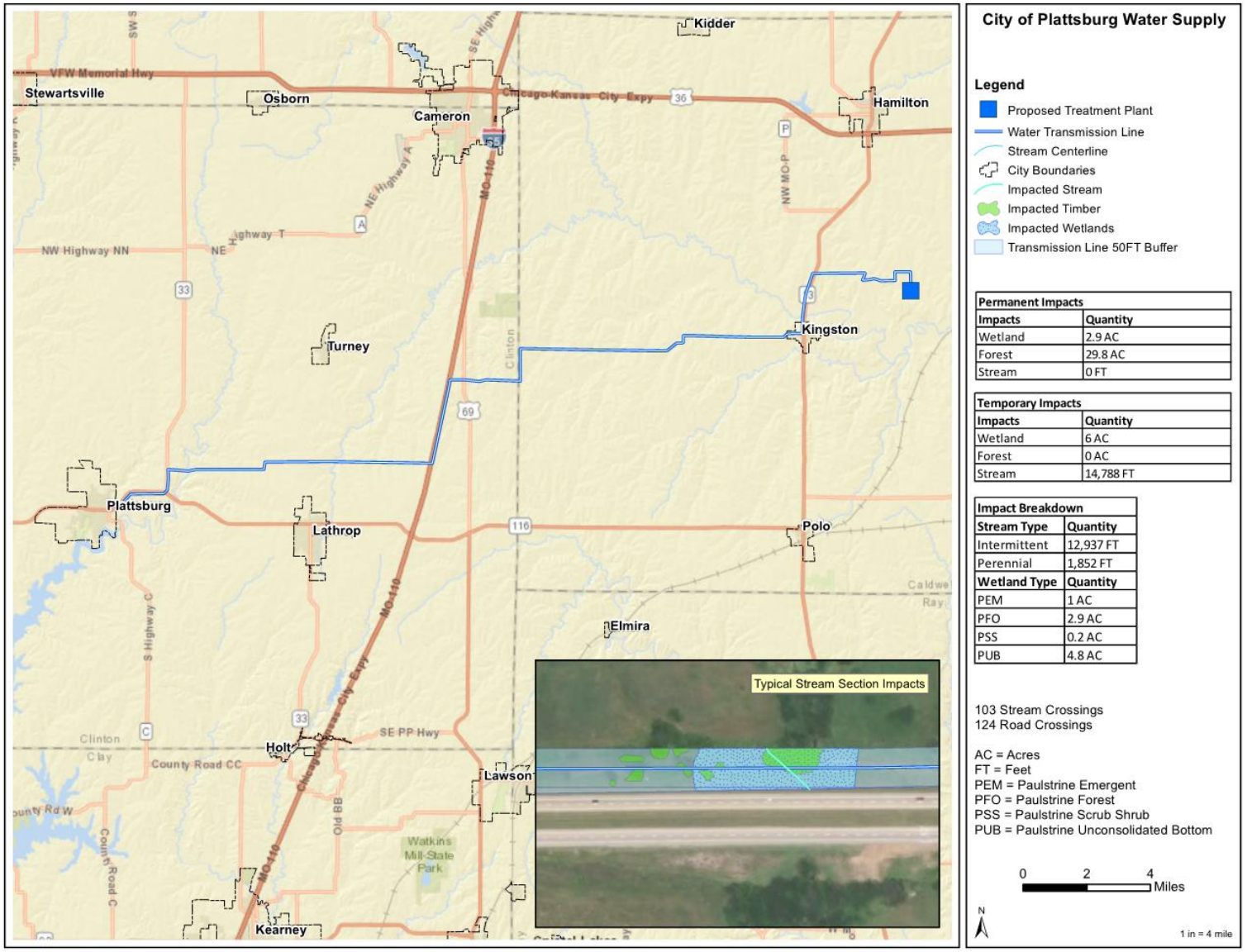


Figure 2.1.2.2-1. City of Plattsburg Water Supply (WA5).

2.1.2.3 Streams and Rivers

Missouri River (WA6)

The Missouri River has adequate capacity, but the water would require treatment to remove iron (MDNR 2007). Pumping water from the Missouri River to Caldwell County is expected to require an estimated five booster stations, 128 road crossings, and 60 stream crossings. Many of the road crossings would require directional boring, and most of the stream crossings would require encasing the water line. The wells and pump stations would also require construction of additional access roads and supporting infrastructure. Figure 2.1.2.3-1 illustrates a concept of this alternative.

The pump stations could likely be located to have minimal impacts on wetlands, streams, and forests, but access roads to them and the 42.5-mile-long water line could not be designed to avoid such impacts. This line would generally be aligned adjacent to existing roads for ease of construction and to minimize impacts on previously undisturbed areas, but some impacts are inevitable. Impacts to or relocation of utilities would occur in coordination with the local utilities. Impacts to county roads and state highways would occur in coordination with the county and with MoDOT.

The transmission line is estimated to affect 54 stream crossings and 6,900 feet of stream. Directional boring would be completed at an estimated 10 major stream crossings, which would reduce stream impacts by 100 feet per crossing. This would result in a reduction of 1,000 feet of stream impacts. The remaining 50 stream crossings would result in an estimated 5,900 feet of stream impacts. However, these impacts would be temporary since stream conditions would be restored to preconstruction conditions once the project is completed. Temporary stream impacts would include an open trench and backfill to previous elevations and contours. Based on NWI, this alternative would result in an estimated 1.9 acres of permanent wetland impacts, which were determined by the acreage of PFO wetlands affected. Based on the NLCD, upland forest impacts are estimated to be 29.3 acres. Forest impacts are considered permanent since trees would be removed. Temporary impacts include an estimated 3.8 acres of wetlands and an estimated 5,900 feet of streams. This alternative would also require the Caldwell County Commission to acquire or otherwise control land outside of Caldwell County including the land for the wells and easements for transmission lines.

This alternative can produce a reliable water yield and meets the selection criteria. Further discussion of the Missouri River pipeline is included in the multipurpose analysis.

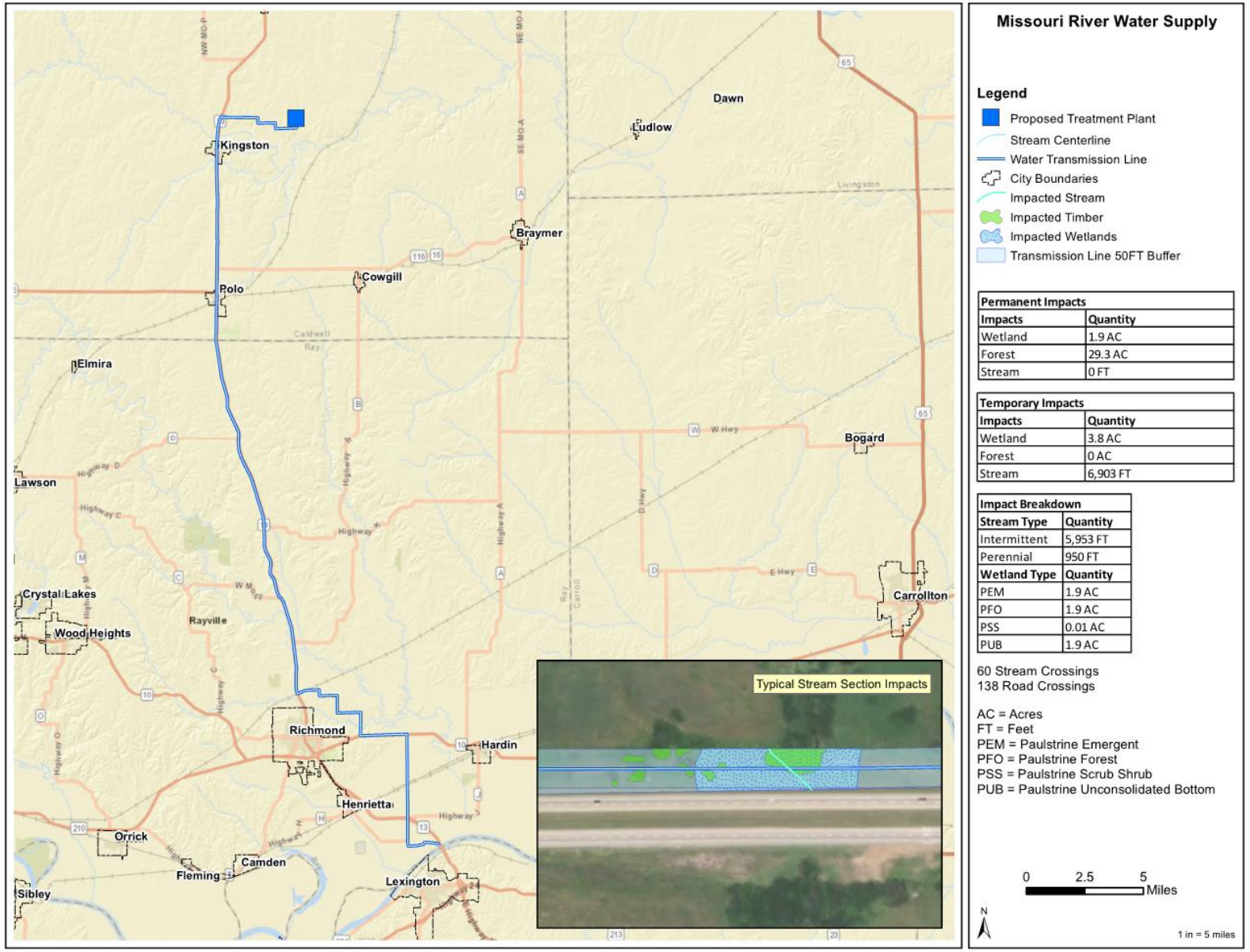


Figure 2.1.2.3-1. Missouri River (WA6).

Shoal Creek Pipeline and Offline Storage (WA7)

Shoal Creek is the largest creek within the county, and a surface water intake located on Shoal Creek would be the only reasonable source for a surface water intake in Caldwell County (Figure 2.1.2.3-2). The drainage area of Shoal Creek is 242 square miles near the town of Kingston in the center of the county, and it is 391 square miles near Braymer. Flows from streams in the area are highly dependent on surface runoff and maintaining required minimum flows would reduce the amount of water that would be available for processing.

In 2013, U.S. Geological Survey (USGS) published a report that developed regression equations for estimating low-flow frequency statistics (Southard 2013). Application of these regression equations at the USGS gauge number 06899700 on Shoal Creek near Braymer produce a 7Q10 = 0.19 cfs at this location. The 7Q10 is the lowest seven-day average flow that occurs on average once every 10 years.

The MDNR's Minimum Design Standards for Missouri Public Water Systems outlines the methods for evaluating the dependability of a Creek water source: the reservoir operation study computer program (RESOP), and the evaluation of the 7Q10. These methods are used with other MDNR design criteria that include the following:

- The ability to provide sufficient water through the drought of record and maintain 120 days of additional storage for public confidence (for reservoirs)
- The ability to maintain other water volume use requirements (for reservoirs)
- The ability to maintain adequate downstream flow for instream flows (MDNR 2013a)

RESOP analysis calculates the reservoir yield capacity, which is the amount of water that can be withdrawn from a reservoir on a daily basis and endure drought of record conditions without depleting the supply.

A 7Q10 threshold is used by MDNR to protect the integrity of the stream, even though, by definition, the flow in the stream will be lower during a drought of record, as that drought is much more severe than a drought that occurs on average every 10 years. If a stream flow source is to be considered dependable, users will be able to withdraw water at a rate that will not cause the stream to be lower than the 7Q10 threshold. By definition, the stream will already be at the 7Q10 threshold in a drought that occurs on average every 10 years, without any withdrawals. Due to periods with inadequate or zero flow, an adjacent storage area (such as an offline reservoir) would be required to provide a reliable water source.

Shoal Creek does not include daily flow records from the 1950's drought of record, so Shoal Creek flows were correlated to flow records from Thompson Creek, a nearby stream in northwestern Missouri. The flow records were analyzed from November 1953 to November 1958 to evaluate installation of a combination of pumps from Shoal Creek and an adjacent offline reservoir, using the following assumptions:

- The assumed pumping rate is 2,500 gpm for an average of 1,000 minutes a day, or 2.5 mgd. This would allow maintaining a peak day pumping flow when Shoal Creek has adequate flow.

- The flow rate pulled from the stream would exclude the 7Q10 value of 0.19 cfs, and water can only be taken from the Creek if flows are above this value.
- The storage reservoir is 40 acres in size with a maximum water depth of 20 feet.

Using these inputs to calculate a water volume balance, an estimated 800 acre-feet of storage would be required during this period of analysis. With the additional storage in an offline reservoir, the resulting maximum average daily water yield for Shoal Creek with the associated offline reservoir is 0.49 mgd, or an estimated 40 percent of the required design flow.

The offline storage reservoir and associated treatment plant would be sited to avoid permanent impacts to wetlands or streams. The pump intake works on Shoal Creek will include a low head stream stabilizing rock structure that will permanently impound water up to six feet deep at the intake point. The intake well and pump house will be located adjacent to the impounded water, and a raw water pipeline would be installed from the pump house to the offline storage location.

Based on NHD and NWI, this alternative would permanently affect an estimated 9,690 feet of stream and 8.7 acres of wetlands. Based on the NLCD, impacts to forests are estimated to be 1.4 acres. Impacts to forest would be permanent since trees would be removed during construction.

This alternative cannot provide a reliable water yield of 1.24 mgd, and it does not meet screening criterion A and is not considered as a stand-alone alternative; however, this alternative could reliably produce 0.49 mgd during the drought of record. It will be evaluated in the water supply combination of alternatives.

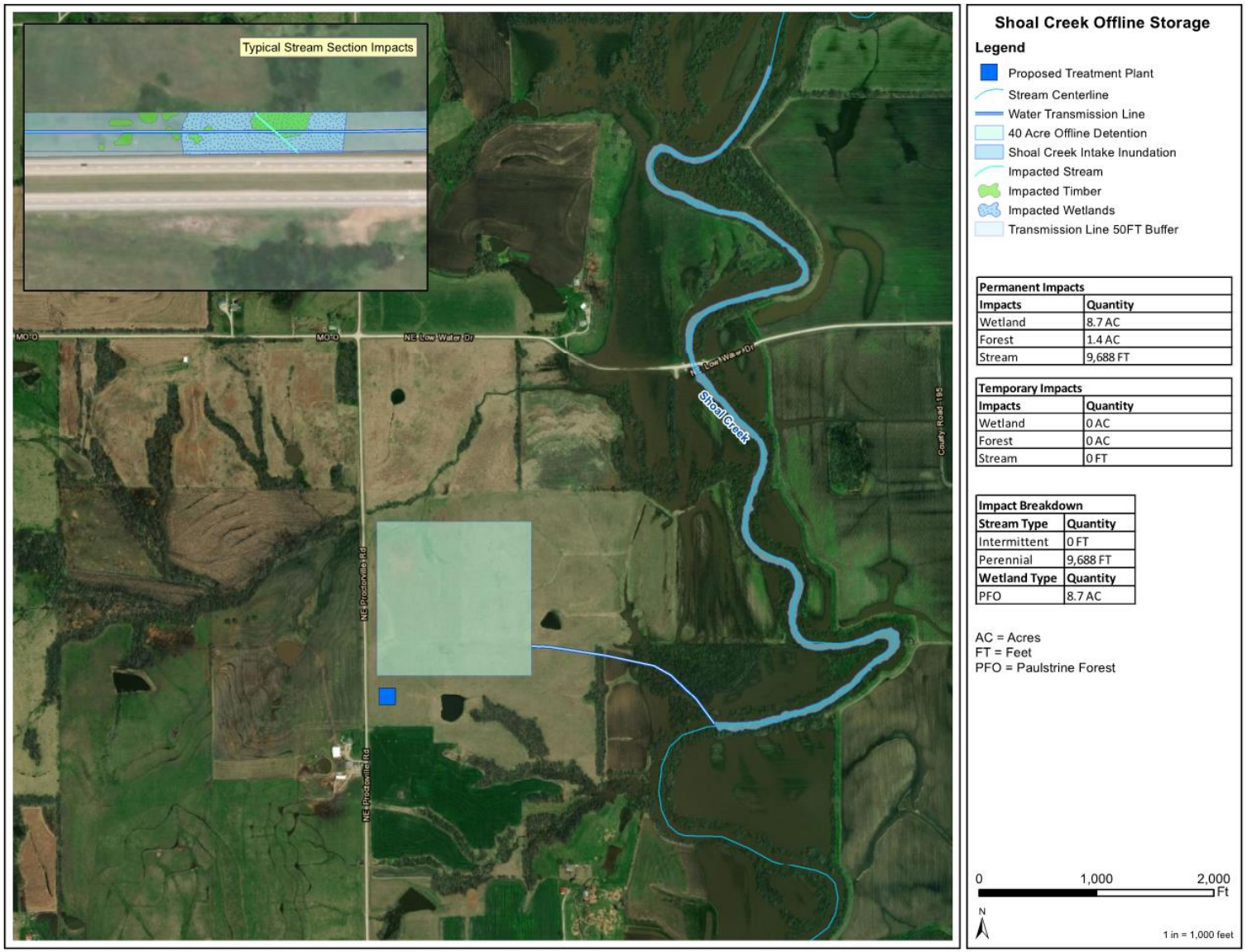


Figure 2.1.2.3-2. Shoal Creek Pipeline and Offline Storage (WA7).

2.1.2.4 Existing Lakes

One surface water source serves Caldwell County. Hamilton Lake supplies the City of Hamilton and Caldwell County PWSD #2. Supplemental water is provided from Livingston PWSD #4 via Daviess PWSD #2. The City of Hamilton also owns a pump station on Marrowbone Creek that has been used to pump supplemental water to Hamilton Lake, but the supplemental water source is unreliable because of silt and low flows in the creek. The City of Breckenridge previously pumped groundwater into Breckenridge Lake from a well that draws water from glacial deposits. The City of Breckenridge now purchases water instead because it was unable to maintain acceptable water quality with the existing system. Both surface sources had been modeled by MDNR and found inadequate to meet existing demand during the drought of record; Breckenridge has already been forced to abandon its surface water supply, and Hamilton Lake may also face that same fate in the future (Edwards et al. 2011).

In 1995, the MDNR published the Surface Water Resources of Missouri (MDNR 1995), which contains a map of estimated total annual runoff. The MDNR map indicates that Caldwell County should average 7 inches of annual runoff. If it is assumed that all this water can be captured and used for water supply (which is unlikely), then a minimum contributing drainage area can be calculated to supply a year's supply of water under the assumption that all the water is converted to water supply. This also assumes that all years receive the average amount of runoff. In drier years, more drainage area would be necessary to achieve the same flow rate. Under these assumptions, supplying 1.24 mgd for a year (assuming no losses of any kind) with 7 inches of runoff would require at least 2,381 acres of contributing drainage area. It is reasonable to assume that some years would be drier and that all runoff would not be captured; therefore, 2,381 acres is the absolute minimum drainage area that might work in some years. However, there are only two existing reservoirs in Caldwell County, and their combined drainage areas total 1,637 acres. These reservoirs cannot possibly be modified to supply the necessary water on their own, but they might be able to contribute to a combined alternative and therefore are discussed in the following sections.

Hamilton Lake (WA8)

The Hamilton Lake alternative (Figure 2.1.2.4-1) would use water storage capacity available in Hamilton Lake and would pump water to the location of the existing water treatment plant (Figure 2.1.2.4-1). Hamilton Lake currently supplies water to the City of Hamilton and Caldwell County PWSD #2. This alternative assumes that Hamilton and Caldwell County PWSD #2 would replace the existing water treatment plant with a new plant in Hamilton and remain part of the regional LOCWWC (both are already members). As described in the 2011 MDNR report (Edwards et al. 2011), the optimal supply is 0.19 mgd. However, based on observations during the drought of 2012, Hamilton Lake will not have any capacity to provide water during the much longer and more severe drought of record.

Since no reliable water supply for the drought of record could be established, this alternative is not carried forward and is eliminated from consideration in the multipurpose analysis or in water supply combination of alternatives.

Breckenridge Lake (WA9)

The Breckenridge Lake alternative would use excess water storage capacity available in Breckenridge Lake and pump the excess water to a proposed new water treatment plant adjacent to the lake. The City of Breckenridge previously pumped groundwater into Breckenridge Lake from a well that draws water from glacial deposits. However, the costs of treating the water to current standards recently became prohibitive, and the use of Breckenridge Lake was discontinued. Without substantial modifications to the existing lake, a reliable water supply at any time, and particularly during drought, cannot be attained.

Since no reliable water supply could be established, this alternative is not carried forward and is eliminated from consideration in the multipurpose analysis or in water supply combination of alternatives.

Hamilton Lake Modification (WA10)

The Hamilton Lake Modification alternative (Figure 2.1.2.4-2) would increase water storage capacity at the existing Hamilton Lake and would provide additional water-based recreational opportunities (see Section 2.3 for recreation discussion). The 1,142-acre watershed to Hamilton Lake can supply a limited amount of reliable water yield during a drought. To determine the maximum water yield Hamilton Lake could supply, it was assumed that the average value of 7 inches of runoff from the entire watershed would be used as water supply. Using this assumption, the volume of available water was calculated to be 0.59 mgd. To maintain this supply during drought, the storage volume of the lake would need to be increased by raising the height of the dam on the existing lake. Using the storage volume to lake area ratio, and using the Proposed Action as a guide, the dam height on Hamilton Lake would need to be increased by an estimated 16 feet, which would result in an additional 3,200 acre-feet of storage. This storage would provide the 0.59 mgd water supply, even with reduced flow in the watershed during a drought. Increasing the dam elevation by 16 feet would require an extensive engineering analysis and would also increase the environmental impacts to the lake.

Environmental impacts associated with this alternative include impacts from increasing the size of the normal pool and dam. Based on NHD and NWI, increased normal pool and dam footprint would permanently affect an estimated 8,590 feet of stream and 24.9 acres of wetlands. Based on the NLCD, impacts to forests are estimated to be 9.5 acres. Impacts to forest would be permanent since trees would be removed during construction. This alternative would also affect portions of the Lakeview golf course, requiring relocation of the facility.

This alternative would require the Caldwell County Commission to acquire or otherwise control land outside of its jurisdiction, including the land required for the infrastructure and land affected by inundation caused by this alternative.

Because this alternative cannot produce 1.24 mgd of raw water supply, it does not meet screening criterion A and is not considered as a stand-alone alternative; however, this alternative could reliably produce 0.59 mgd. It will be evaluated in the water supply combination of alternatives.

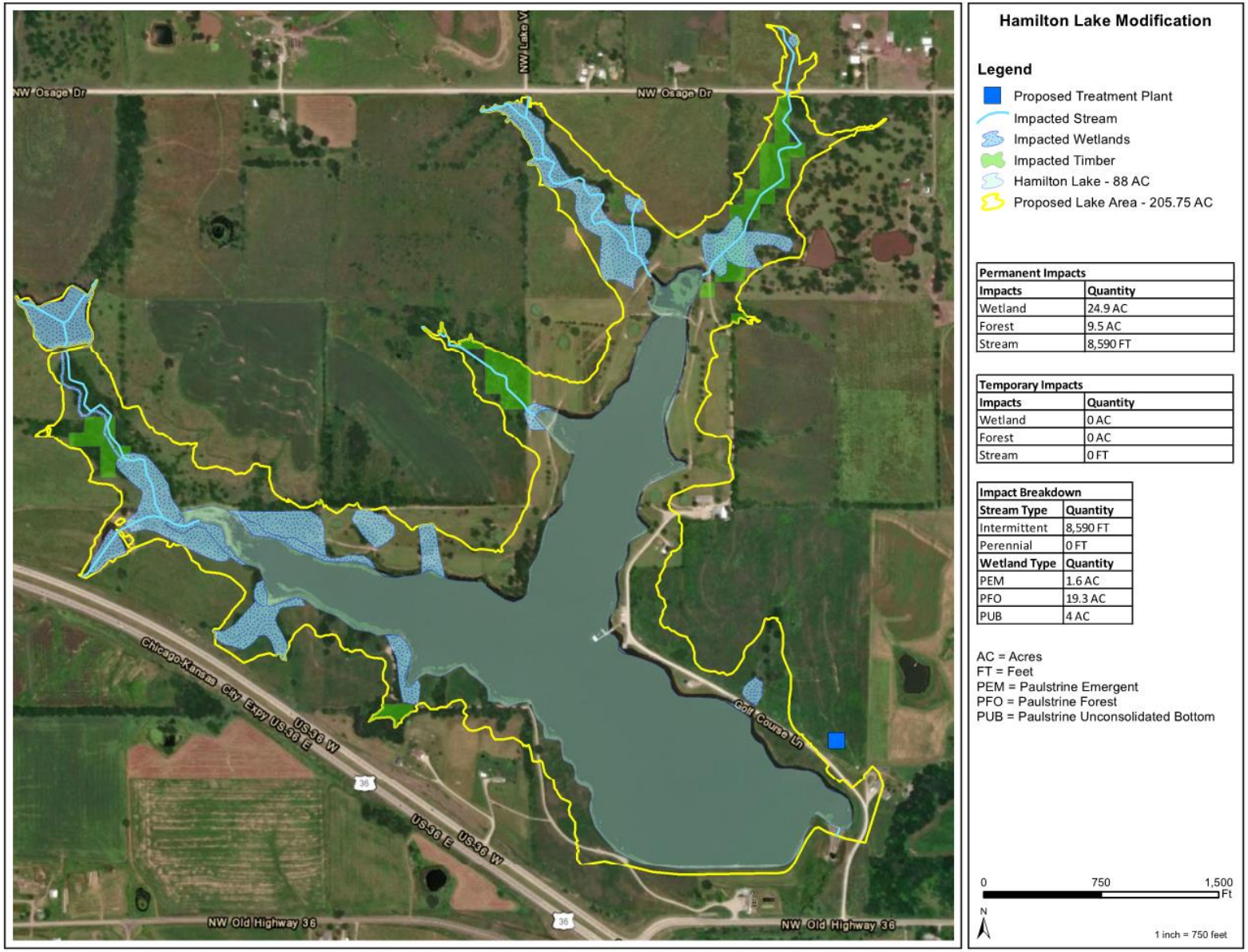


Figure 2.1.2.4-1. Hamilton Lake Modification (WA10).

Breckenridge Lake Modification (WA11)

The Breckenridge Lake Modification alternative (Figure 2.1.2.4-3a) would increase water storage capacity at the existing Breckenridge Lake and would provide additional water-based recreational opportunities (see Section 2.3.2 for recreation discussion). The 412-acre watershed to Breckenridge Lake can supply a limited amount of reliable water yield during a drought. To determine the maximum water yield Breckenridge Lake could supply, it was assumed that the average value of 7 inches of runoff from the entire watershed would be used as water supply. Using this assumption, the volume of available water was calculated to be 0.21 mgd. To maintain this supply during drought, the storage volume of the lake would need to be increased by raising the height of the dam. Using the storage volume to lake area ratio and using the Proposed Action as a guide, the dam on Breckenridge Lake would need to be increased in height by an estimated 9 feet, which would result in an additional 311 acre-feet of storage. The increased storage would allow the lake to provide the 0.21 mgd, even with reduced flow in the watershed during a drought. Increasing the dam elevation would require an extensive engineering analysis and would also increase the environmental impacts to the lake.

Environmental impacts associated with this alternative include impacts from increasing the size of the normal pool and dam.

Based on NHD and NWI, increased normal pool and dam footprint would permanently affect an estimated 1,270 feet of stream and 1.0 acre of wetlands. Based on the NLCD, impacts to forests are estimated to be 7.3 acres. Impacts to forest would be permanent since trees would be removed during construction.

This alternative would require the Caldwell County Commission to acquire or otherwise control land outside of its jurisdiction, including the infrastructure land affected by inundation caused by the increased dam and normal pool size.

Because this alternative cannot produce 1.24 mgd of raw water supply, it does not meet screening criterion A and is not considered as a stand-alone alternative; however, this alternative could reliably produce 0.21 mgd. This alternative will be evaluated in the water supply combination of alternatives.

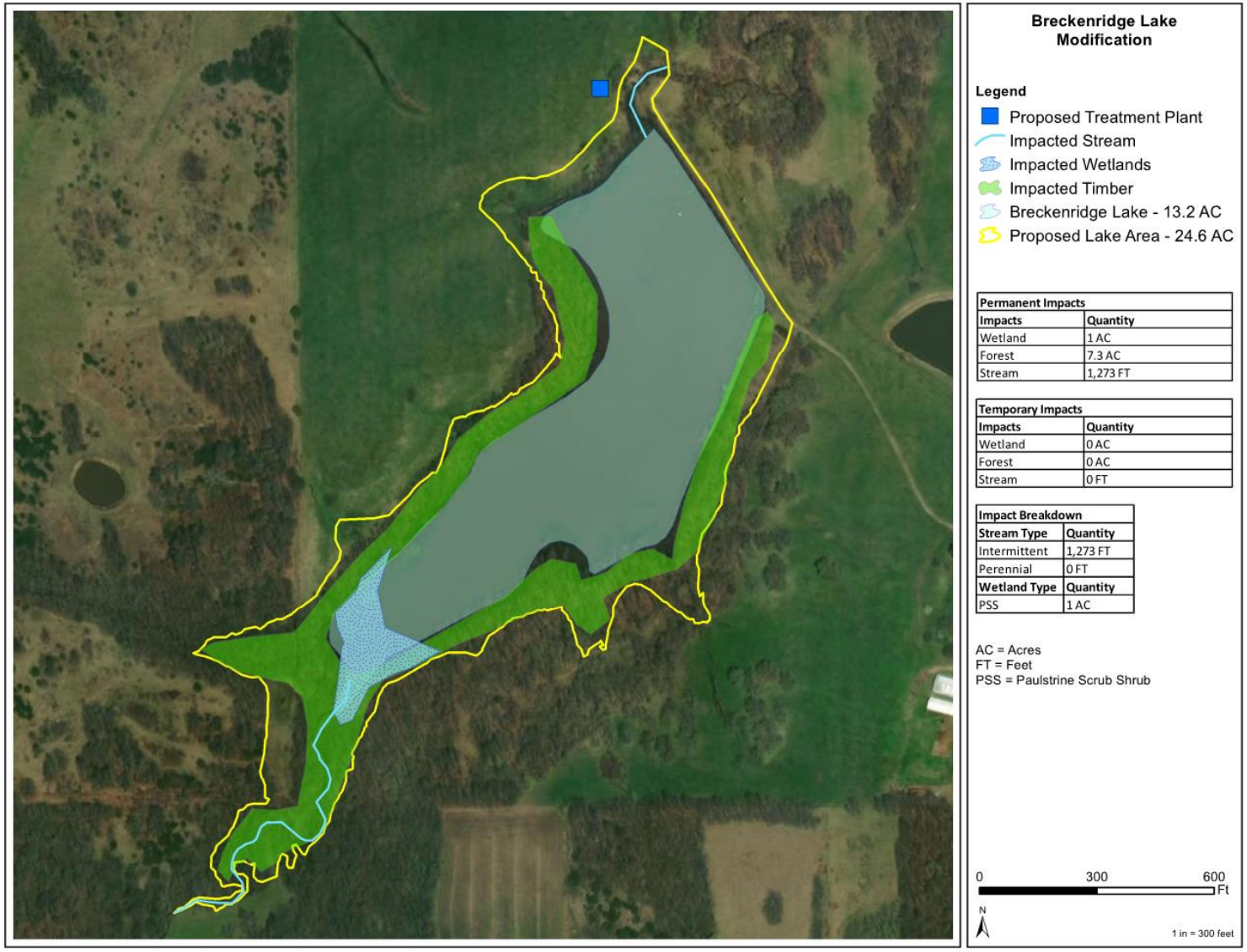


Figure 2.1.2.4-2. Breckenridge Lake Modification (WA11).

2.1.2.5 Creation of a New Reservoir

Creation of an Offline Channel Reservoir (WA12)

To use an offline reservoir effectively, the offline reservoir would need to be sited near a water source where water can be pumped into the reservoir for storage and transmission to a water treatment plant. This pairing is evaluated in Alternative WA7 – Shoal Creek Pipeline and Offline Storage.

Since no reliable water supply can be established with this as a stand-alone alternative, this alternative is not considered in the multipurpose analysis or in the water supply combination of alternatives.

Creation of a New Reservoir – Alternative Locations in Caldwell County

The NRCS evaluated five reservoir locations as part of the Shoal Creek Basin Feasibility Study (USDA-SCS 1991). The five sites are described below and are based on the USDA Soil Conservation Service's 1991 report. The Little Otter Creek Reservoir – Proposed Action (Multipurpose Alternative 1) is identified in the 1991 report as "site 1" and is located on Little Otter Creek. Figure 2.1.2.5-1 shows the alternative reservoir locations.

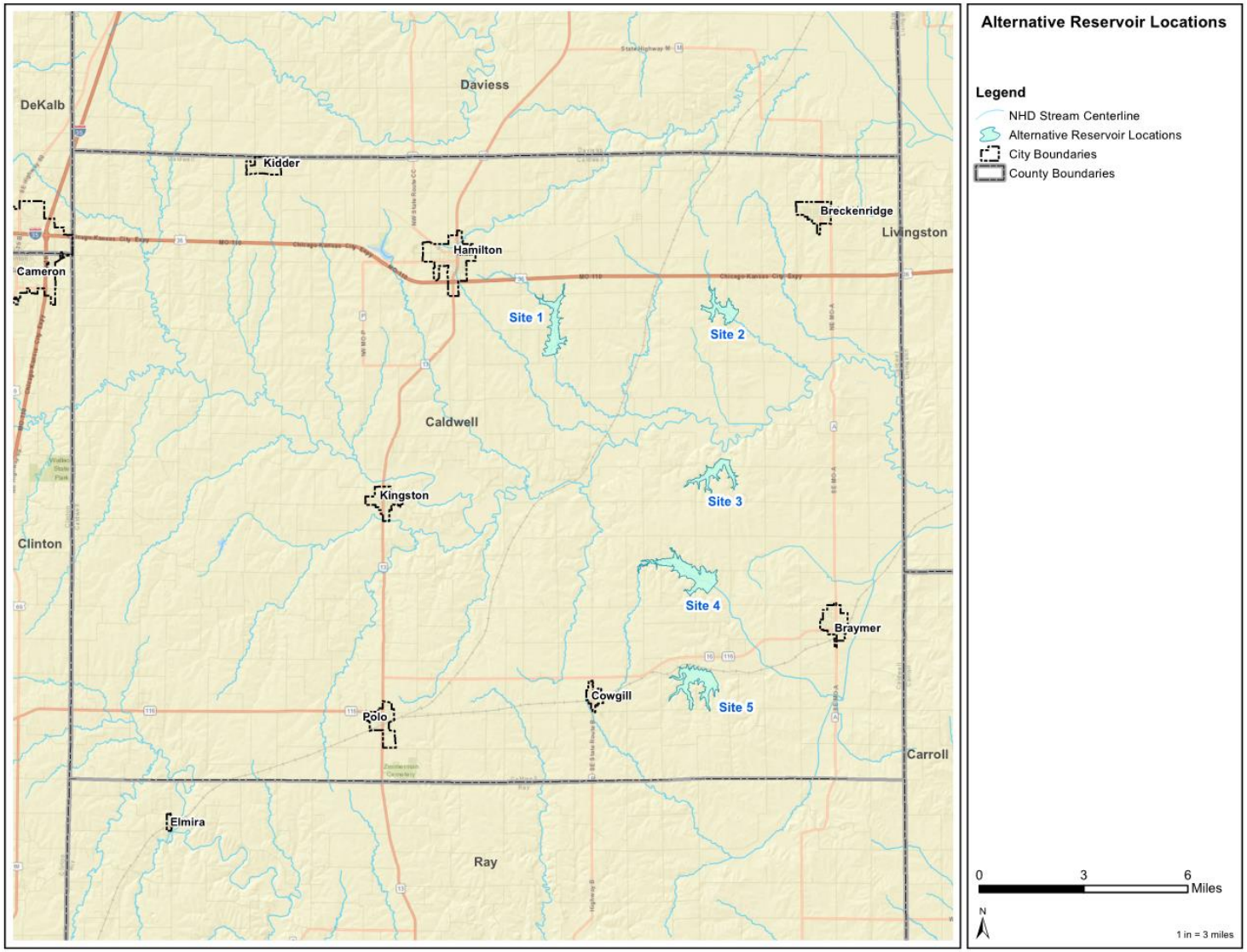


Figure 2.1.2.5-1. Alternative Reservoir Locations.

Little Otter Creek Reservoir – Proposed Action (MA1)

The Proposed Action is to create a 344-acre lake by installing an earthen dam, which would impound water on Little Otter Creek to provide 1.24 mgd of drinking water. The Little Otter Creek watershed is located entirely within Caldwell County. Little Otter Creek, which drains an area of 6,323 acres at its confluence with Otter Creek, originates approximately 2 miles east of Hamilton, Missouri, and flows south-southeast to its outlet at Otter Creek about 1 mile southeast of the unincorporated community of New York, Missouri. The reservoir would provide an estimated 4,920 acre-feet of volume for water supply.

The Proposed Action (Figure 2.1.2.5-2) would provide a new, clean, and reliable source of raw water sufficient to meet the demand during conditions equivalent to the drought of record. Recreational facilities including a boat ramp, docks, access lane, and parking spaces would be constructed to support recreational opportunities. Portions of Northeast Ridgeway Drive and Northeast Ponderosa Road would be inundated as a result of the Proposed Action, which would result in the closure of those roads. The Proposed Action would also impact Northeast Sandstone Drive, potentially requiring the construction of bridges. Relocation of utilities, if required, would occur in coordination with the local utilities.

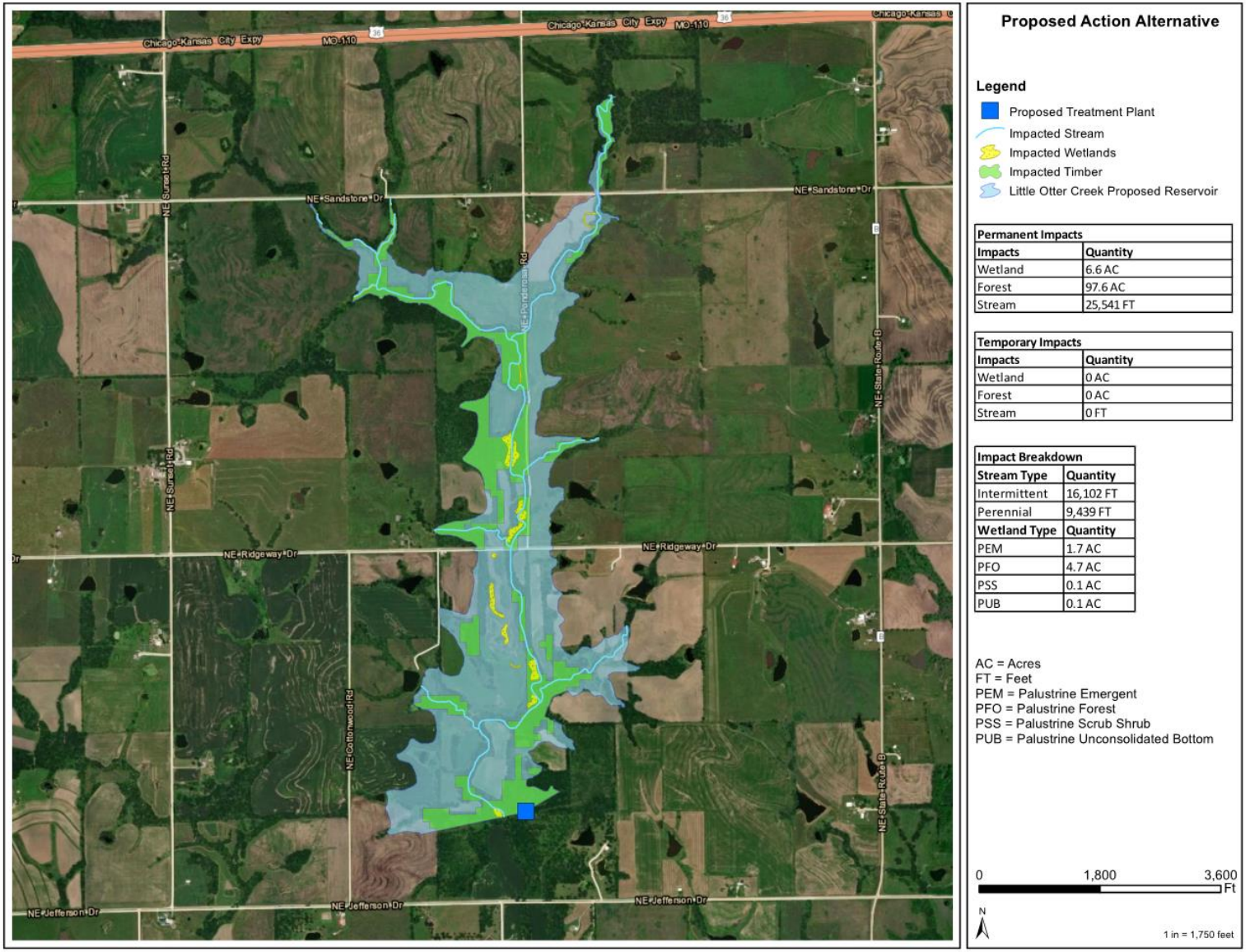
For a description of the flood damage reduction screening criteria, see Section 2.2.2. The Proposed Action would reduce flood damages by 84 percent on the 3.8 miles of Little Otter Creek between Northeast Jefferson Drive and the confluence with Otter Creek. The Proposed Action would result in a flood damage reduction benefit of $89,700 annually and reduce peak flow. A total of 104 acres of former cropland would be inundated by the Proposed Action.

For a description of the water-based recreation screening criteria, see Section 2.3.1. Based on the standard of 166 annual user-days per acre used in the 2003 FEIS, the Proposed Action would provide an estimated 57,104 annual user-days to meet more than 45 percent of the unmet demand for the study area.

USACE conducted a jurisdictional wetland and stream delineation in 2009 and issued an AJD in 2010. The AJD was reissued in 2015. The AJD documented the extent of wetlands and jurisdictional waters of the U.S. within the Proposed Action project area. Based on the AJD, the Proposed Action would affect 36,243 feet of stream channel and 4.1 acres of wetlands, mostly through inundation (USACE 2010).

For consistency in comparing all alternatives, the NWI, NHD, and NLCD databases were used to determine wetland, stream, and forest impacts for all alternatives including the Proposed Action. Based on NWI and NHD, the Proposed Action would permanently affect an estimated 6.6 acres of wetlands and 25,540 feet of stream channel. Based on the NLCD, permanent upland forest impacts are estimated to be 97.6 acres.

This alternative meets the project purposes and screening criteria for water supply, flood damage reduction, and water-based recreation and therefore will be carried forward for the multipurpose analysis.



Permanent Impacts	
Impacts	**Quantity**
Wetland	6.6 AC
Forest	97.6 AC
Stream	25,541 FT

Temporary Impacts	
Impacts	**Quantity**
Wetland	0 AC
Forest	0 AC
Stream	0 FT

Impact Breakdown	
Stream Type	**Quantity**
Intermittent	16,102 FT
Perennial	9,439 FT
Wetland Type	**Quantity**
PEM	1.7 AC
PFO	4.7 AC
PSS	0.1 AC
PUB	0.1 AC

AC = Acres
FT = Feet
PEM = Palustrine Emergent
PFO = Palustrine Forest
PSS = Palustrine Scrub Shrub
PUB = Palustrine Unconsolidated Bottom

Figure 2.1.2.5-2. Little Otter Creek – Proposed Action (MA1).

Alternative Reservoir Location – Site 2 (DPA1)

Alternative Reservoir Location – Site 2 would create a 218-acre lake by constructing an earthen dam that would impound water of Turkey Creek (Figure 2.1.2.5-3). The proposed lake would have a surface area of 218 acres at normal pool, including 7,275 acre-feet of storage and a maximum depth of 67 feet. Site 2 is located on Turkey Creek near the center of the eastern half of Section 30, Township 57 North, Range 26 West. Alternative Reservoir Location – Site 2 was determined to have inadequate drainage area necessary to provide adequate water supply. Based on the drainage area, this location could provide an estimated 0.80 mgd of water.

Additionally, this alternative could supply an estimated 36,188 annual user-days (or 36 percent of unmet demand), which is below the 45 percent of unmet water-based recreation demand; however, it might be able to be combined with other alternatives. For a description of the water-based recreation screening criteria, see Section 2.3.1.

Environmental impacts associated with this alternative include areas inundated by creation of the reservoir and the area affected by the dam. Based on the NHD, NWI, and NLCD, this alternative would permanently affect an estimated 17,040 feet of stream channel, 4.9 acres of wetlands, and 103 acres of upland forest.

Alternative Reservoir Location – Site 2 does not meet screening criterion A for either water supply or water-based recreation and is not considered as a stand-alone alternative. However, this alternative could reliably produce 0.80 mgd of raw water and 36 percent of the unmet demand for water-based recreation. This alternative will be evaluated in the water supply combination of alternatives and the water-based recreation combination of alternatives.

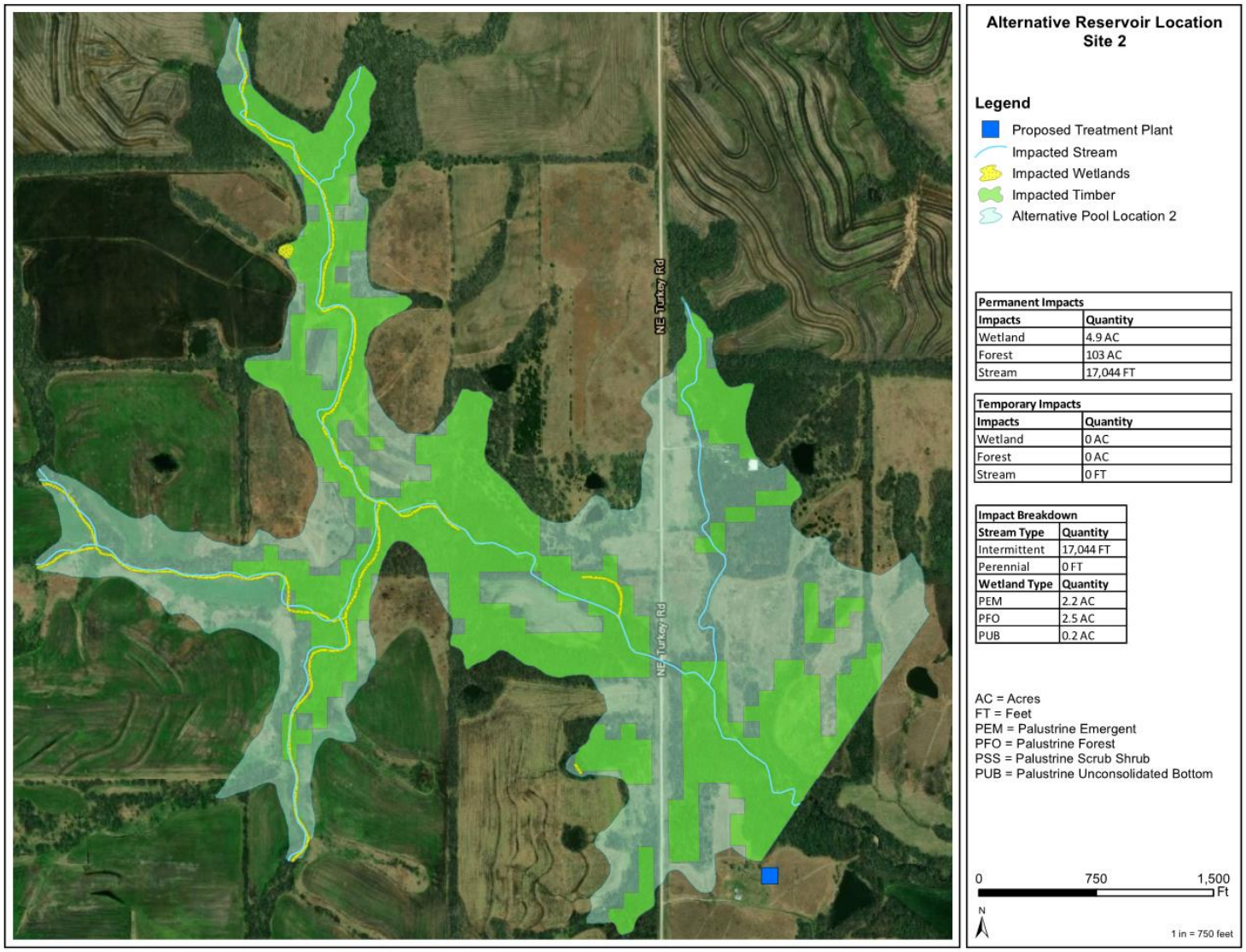


Figure 2.1.2.5-3. Alternative Reservoir Location – Site 2 (DPA1).

Alternative Reservoir Location – Site 3 (DPA2)

Alternative Reservoir Location – Site 3 would create a 233-acre lake by constructing an earthen dam that would impound water of an unnamed tributary of Shoal Creek (Figure 2.1.2.5-4). The proposed lake would have a surface area of 233 acres at normal pool, including 8,451 acre-feet of storage and a maximum depth of 74 feet. Alternative Reservoir Location – Site 3 is in the southeastern corner of Section 18, Township 56 North, Range 26 West. Based on the drainage area, this location could provide an estimated 0.80 mgd of water.

Additionally, this alternative could supply an estimated 38,678 annual user-days (or 38 percent of unmet demand), which is below the 45 percent of unmet water-based recreation demand; however, it might be able to be combined with other alternatives. For a description of the water-based recreation screening criteria, see Section 2.3.1.

Environmental impacts associated with this alternative include areas inundated by creation of the reservoir and the area affected by the dam,. Based on the NHD, NWI, and NLCD, this alternative would permanently affect an estimated 23,600 feet of stream channel, 3.9 acres of wetlands, and 196 acres of upland forest.

Alternative Reservoir Location – Site 3 does not meet screening criterion A for either water supply or water-based recreation and is not considered as a stand-alone alternative. However, this alternative could reliably produce 0.80 mgd of raw water and 38 percent of the unmet demand for water-based recreation. This alternative will be evaluated in the water supply combination of alternatives and the water-based recreation combination of alternatives.

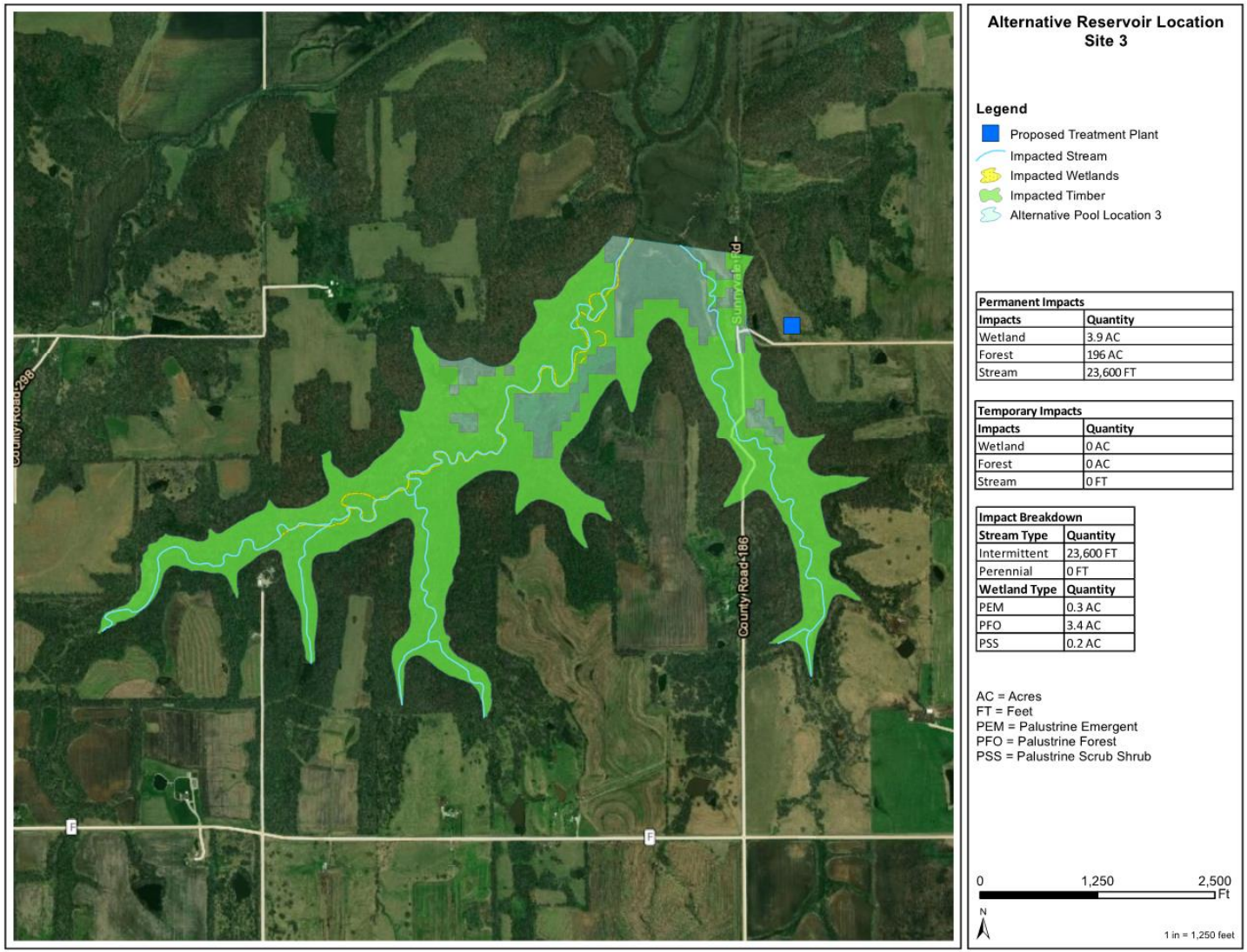


Figure 2.1.2.5-4. Alternative Reservoir Location – Site 3 (DPA2).

Alternative Reservoir Location – Site 4 (DPA3)

Alternative Reservoir Location – Site 4 alternative would create a 493-acre lake by constructing an earthen dam that would impound water of North Mud Creek (Figure 2.1.2.5-5). The proposed lake would have a surface area of 493 acres at top of dam, including 6,440 acre-feet of storage and a maximum depth of 52 feet. Alternative Reservoir Location – Site 4 is located on North Mud Creek in the northeastern corner of Section 1, Township 55 North, Range 27 West. Site 4 would affect three county roads and State Highway B. Moving the site to avoid State Highway B would reduce the drainage area and thus limit water supply yield. The current location could provide 1.24 mgd.

Additionally, this alternative could supply an estimated 81,838 annual user-days (or 82 percent of unmet demand) to meet the 45 percent or more of unmet water-based recreation demand. For a description of the water-based recreation screening criteria, see Section 2.3.1.

Environmental impacts associated with this alternative include areas inundated by creation of the reservoir and acres affected by the dam.. Based on the NHD, NWI, and NLCD, this alternative would permanently affect an estimated 38,630 feet of stream channel, 8.8 acres of wetlands, and 123.4 acres of forest.

This alternative meets the water supply and water-based recreation screening criteria. It will be considered a viable alternative and will be carried forward for the multipurpose analysis.

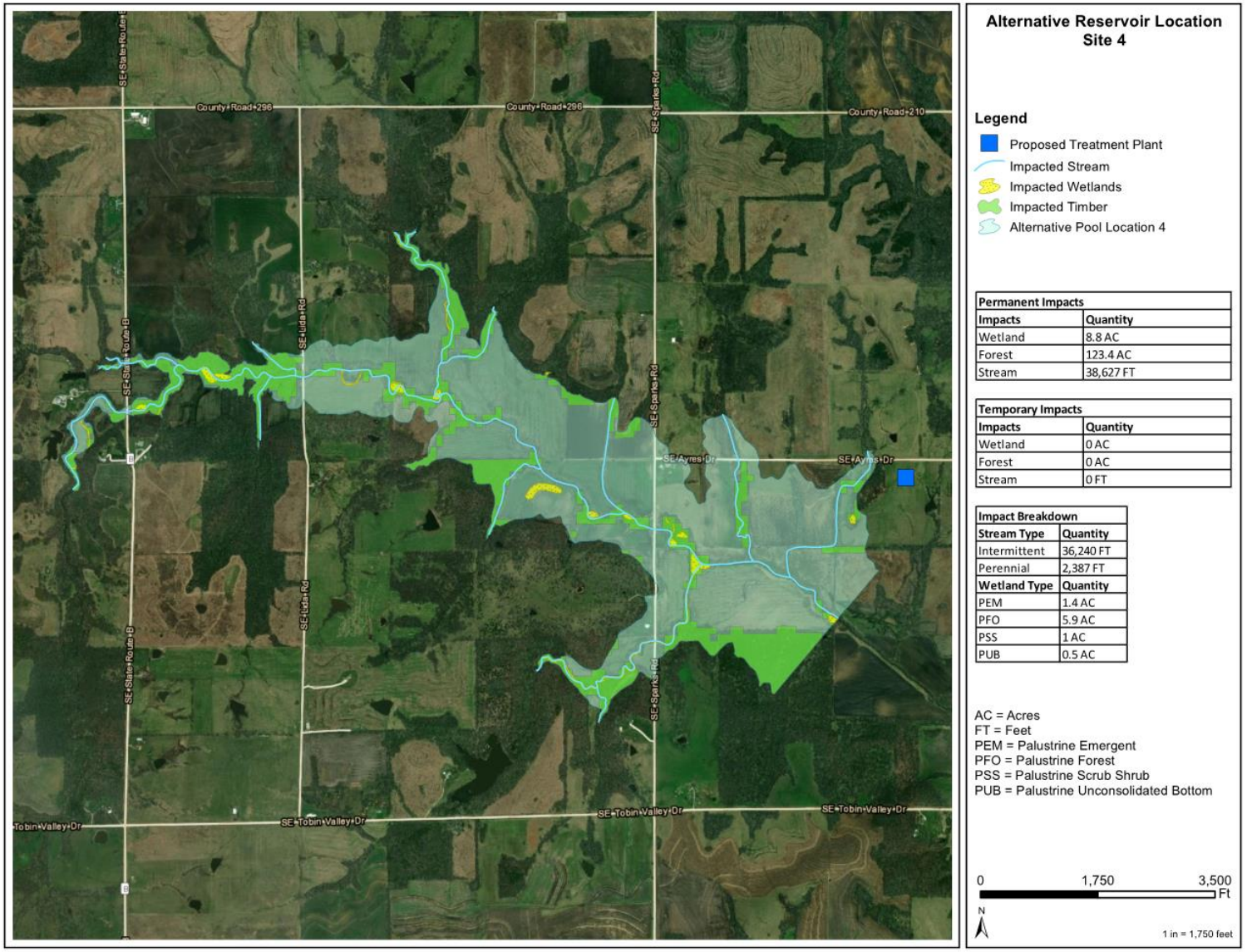


Figure 2.1.2.5-5. Alternative Reservoir Location – Site 4 (DPA3).

Alternative Reservoir Location – Site 5 (DPA4)

This alternative would create a 427-acre lake by constructing an earthen dam that would dam water of an unnamed tributary of North Mud Creek (Figure 2.1.2.5-6). The proposed lake would have a surface area of 427 acres at top of dam, including 6,269 acre-feet of storage and a maximum depth of 58 feet. Site 5 is located on an unnamed tributary in the northwestern corner of Section 19, Township 55 North, Range 26 West. Site 5 is the greatest distance from the water customers, would affect a railroad and two county roads, and has a quarry upstream of the reservoir that could affect water quality. The current location could provide 1.24 mgd. Impacts to state highways would require coordination with MoDOT.

Additionally, this alternative could supply an estimated 70,882 annual user-days (or 71 percent of unmet demand) to meet the 45 percent or more of unmet water-based recreation demand. For a description of the water-based recreation screening criteria, see Section 2.3.1.

Environmental impacts associated with this alternative include areas inundated by creation of the reservoir and the area affected by the dam. Based on the NHD, NWI, and NLCD, this alternative would permanently affect an estimated 33,580 feet of stream channel, 10.9 acres of wetlands, and 157.8 acres of forest.

This alternative meets the water supply and water-based recreation screening criteria. It will therefore be considered a viable alternative and will be carried forward for the multipurpose analysis.

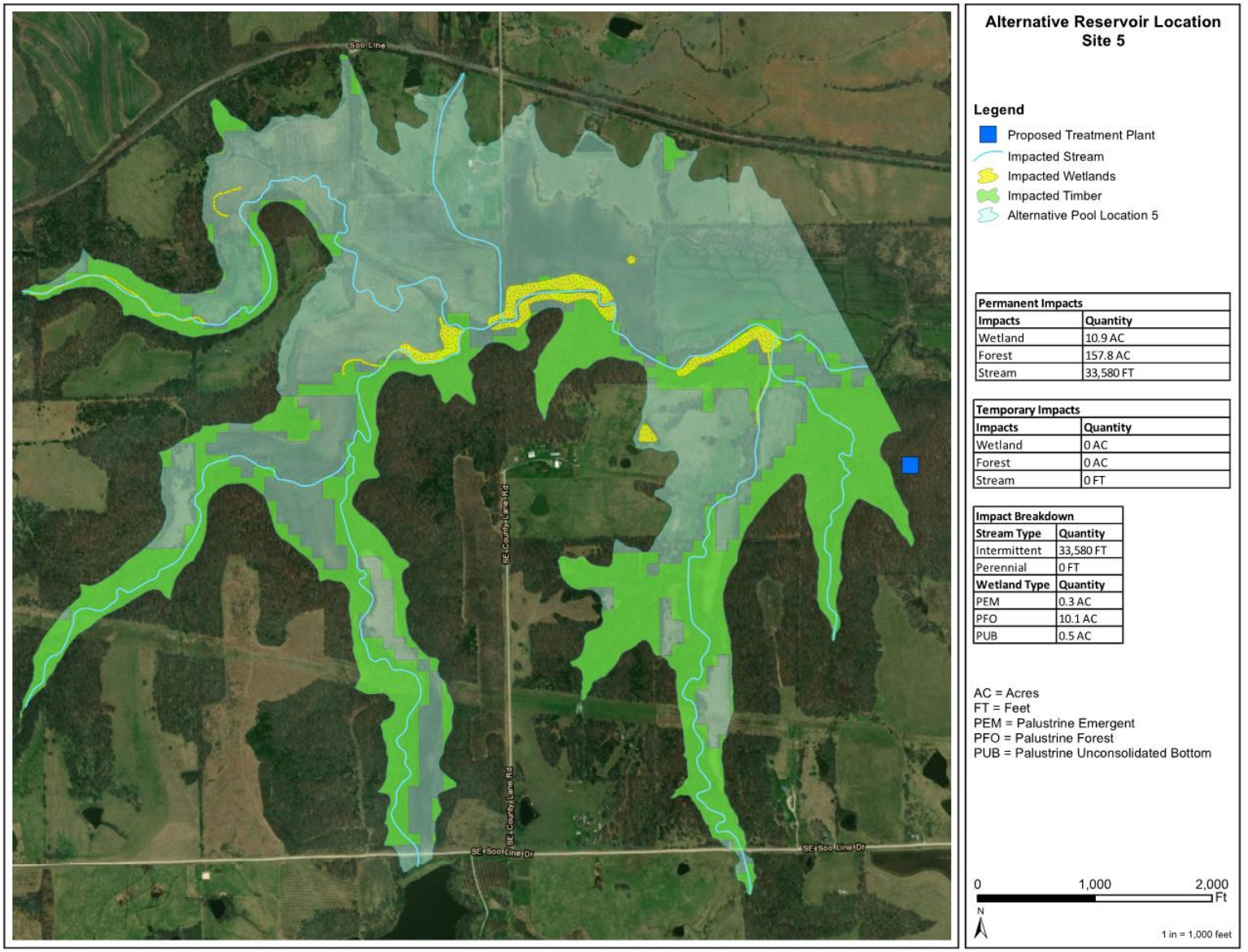


Figure 2.1.2.5-6. Alternative Reservoir Location – Site 5 (DPA4).

2.1.3 Summary of Water Supply Alternatives Screening Process

Table 2.1.3-1 summarizes the individual water supply alternatives, how much volume they could produce, and whether or not they met all the screening criteria. The following alternatives were eliminated from consideration because they did not meet the water supply purpose and need.

- No Action Alternative (carried forward for baseline comparison)
- WA1 – Deep Aquifer Groundwater Sources in Caldwell County
- WA2 – Shallow Alluvial Groundwater Sources in Caldwell County
- WA3 – Great Northwest Wholesale Water Commission or some other source at Cameron
- WA4 – City of Chillicothe Water Supply
- WA8 – Hamilton Lake
- WA9 – Breckenridge Lake
- WA12 – Creation of an Offline Channel Reservoir

Alternatives that met the water supply purpose and need will be further described in the multipurpose analysis and are included below.

- WA5 – City of Plattsburg Water Supply
- WA6 – Missouri River
- DPA3 – Alternative Reservoir Location – Site 4
- DPA4 – Alternative Reservoir Location – Site 5
- MA1 – Little Otter Creek Reservoir – Proposed Action

Table 2.1.3-1. Summary of Water Supply Alternatives Screening.

Alternative	Meets Criteria (Y/N)	Screening Criteria			
		Criterion A Water Supply (1.24 mgd) and Dependability in Drought	Criterion B Codes and Regulations	Criterion C Affordable Finished Water Supply	Criterion D Willing Participation
No Action	N	N (0.00 mgd)	N	N	N
WA1. Deep Aquifer Groundwater Sources in Caldwell County	N	N (0.00 mgd)	Y	N	Y
WA2. Shallow Alluvial Groundwater Sources in Caldwell County	N	N (0.00 mgd)	Y	Y	Y
WA3. Great Northwest Wholesale Water Commission or some other source at Cameron	N	N (0.00 mgd)	Y	Y	Y
WA4. City of Chillicothe Water Supply	N	Y (1.24 mgd)	Y	Y	N
WA5. City of Plattsburg Water Supply	Y	Y (1.24 mgd)	Y	Y	Y
WA6. Missouri River	Y	Y (1.24 mgd)	Y	Y	Y
WA7. Shoal Creek Pipeline and Offline Storage	N	N (0.49 mgd)	Y	Y	Y
WA8. Hamilton Lake	N	N (0.00 mgd)	Y	Y	Y
WA9. Breckenridge Lake	N	N (0.00 mgd)	Y	N	Y

Alternative	Meets Criteria (Y/N)	Screening Criteria			
		Criterion A Water Supply (1.24 mgd) and Dependability in Drought	Criterion B Codes and Regulations	Criterion C Affordable Finished Water Supply	Criterion D Willing Participation
WA10. Hamilton Lake Modification	N	N (0.59 mgd)	Y	Y	Y
WA11. Breckenridge Lake Modification	N	N (0.21 mgd)	Y	Y	Y
WA12. Creation of an Offline Channel Reservoir	N	N (0.00 mgd)	Y	N	Y
MA1. Little Otter Creek Reservoir – Proposed Action	Y	Y (1.24 mgd)	Y	Y	Y
DPA1. Alternative Reservoir Location – Site 2	N	N (0.80 mgd)	Y	Y	Y
DPA2. Alternative Reservoir Location – Site 3	N	N (0.80 mgd)	Y	Y	Y
DPA3. Alternative Reservoir Location – Site 4	Y	Y (1.24 mgd)	Y	Y	Y
DPA4. Alternative Reservoir Location – Site 5	Y	Y (1.24 mgd)	Y	Y	Y

2.1.4 Combination of Water Supply Alternatives

This section includes analysis of alternatives that provided some volume of water during drought conditions, but which do not individually meet the water supply purpose and need as determined through the screening criteria.

Table 2.1.3-1 shows the water supply alternatives and their abilities to meet the screening criteria. Water supply alternatives that did not meet screening criterion A but supplied some volume of water were considered for combining with another alternative. Water supply alternatives that did not meet screening criteria B, C, or D were not considered for the combination alternatives because combining them with another alternative would not meet the screening criteria and water supply purpose and need.

The list of alternatives that could be considered for a combination alternative include:

- Shoal Creek Pipeline and Offline Storage (WA7)
- Hamilton Lake Modification (WA10)
- Breckenridge Lake Modification (WA11)
- Alternative Reservoir Location – Site 2 (DPA1)
- Alternative Reservoir Location – Site 3 (DPA2)

These five alternatives could be combined in many potential ways. To simplify the process, the combination of water supply alternatives that could provide at least 1.24 mgd of water with the fewest environmental impacts to streams, wetlands, or forests will be further considered for final alternatives analysis.

Combination of Alternative Reservoir Location – Site 2 and Alternative Reservoir Location – Site 3 (DPA5)

A combination of Alternative Reservoir Location – Site 2 and Alternative Reservoir Location – Site 3 would provide 1.6 mgd of water and meets the screening criteria. This combination alternative results in the fewest permanent wetland impacts and will be further evaluated in the preferred alternative analysis. Table 2.1.4-1 summarizes the estimated environmental impacts of this combination alternative.

Table 2.1.4-1. Combination of Alternative Reservoir Location – Site 2 and Alternative Reservoir Location – 3 (DPA5).

Alternative	Water Supply (1.24 mgd) and Dependability in Drought	Permanent Wetland Impacts (acres)	Permanent Stream Impacts (feet)	Permanent Upland Forest Impacts (acres)
Alternative Reservoir Location – Site 2	0.80	4.9	17,040	103
Alternative Reservoir Location – Site 3	0.80	3.9	23,600	196
TOTALS	**1.6**	**8.8**	**40,640**	**299**

Combination of Shoal Creek Pipeline and Offline Storage, Hamilton Lake Modification, and Breckenridge Lake Modification (WA13)

Combining the Shoal Creek Pipeline and Offline Storage alternative, the Hamilton Lake Modification alternative, and the Breckenridge Lake Modification alternative provides 1.29 mgd of water and has the fewest permanent stream and upland forest impacts. This combination alternative meets the screening criteria and will be further evaluated in the multipurpose analysis. Table 2.1.4-2 summarizes the estimated environmental impacts of this combination alternative.

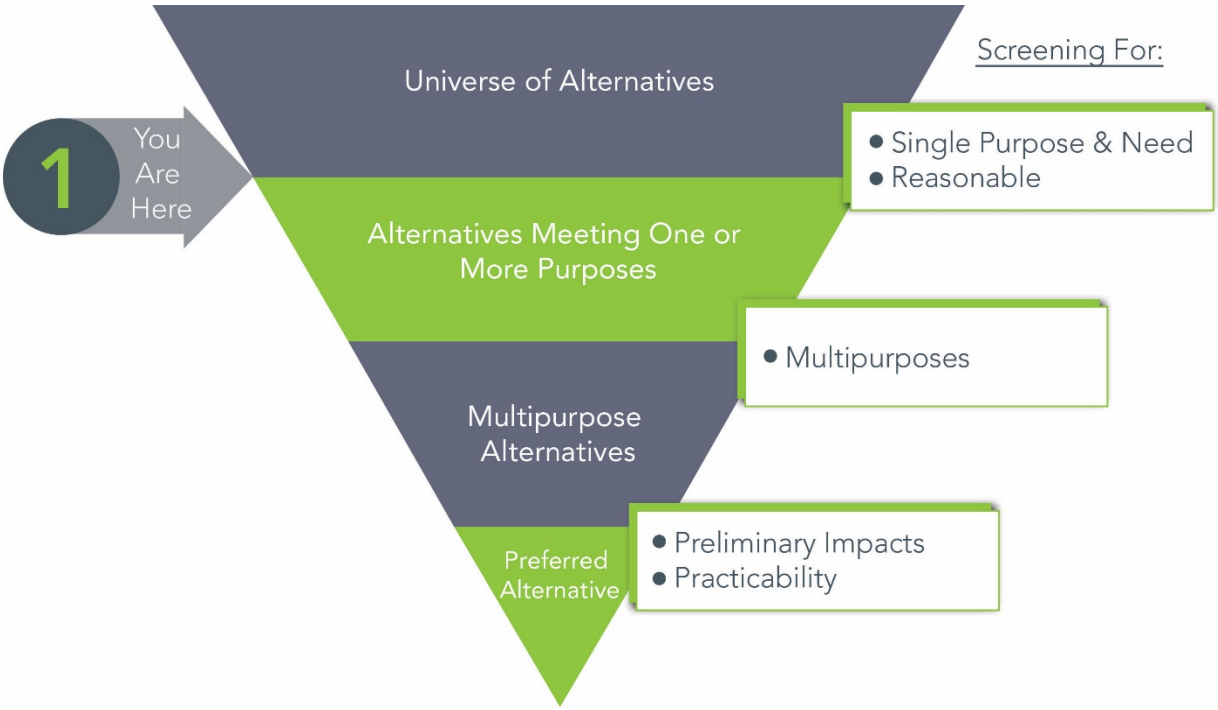
Table 2.1.4-2. Combination of Shoal Creek Pipeline and Offline Storage, Hamilton Lake Modification, and Breckenridge Lake Modification (WA13).

Alternative	Water Supply (1.24 mgd) and Dependability in Drought	Permanent Wetland Impacts (acres)	Permanent Stream Impacts (feet)	Permanent Upland Forest Impacts (acres)
Shoal Creek Pipeline and Offline Storage	0.49	8.7	9,690	1.4
Hamilton Lake Modification	0.59	24.9	8,590	9.5
Breckenridge Lake Modification	0.21	1.0	1,270	7.3
TOTALS	**1.29**	**34.6**	**19,550**	**18.2**

2.2 Flood Damage Reduction Alternatives Analysis

One of the project purposes and needs is to reduce flood damages along Little Otter Creek. The geographic area where flood prevention is required is 3.8 miles of Little Otter Creek between Northeast Jefferson Drive and the confluence with Otter Creek. Without flood damage mitigation, substantial threat of flooding from major storms would continue. All the alternatives are directly focused on the study area location between Northeast Jefferson Drive and the confluence with Otter Creek. See Figure 1.2.3-1 for a map of the flood damage reduction area.

A goal of 60 percent reduction in annual flood damages was selected. This value is high enough to provide significant benefits but low enough to allow analysis of a reasonable range of alternatives. Table 2.2-1 provides the list of alternatives considered.



This section screens the universe of flood damage reduction alternatives.

Table 2.2-1. Flood Damage Reduction Alternatives.

	No Action Alternative
FA1	Zoning
FA2	Floodplain Acquisition
FA3	Conservation Measures
FA4	Wetland Storage Areas
FA5	Conveyance
FA6	Construct Levees and Raise Bridges
FA7	Valley Encroachment Berms
FA8	Small Detention Structures
FA9	Dry Dam Detention 100-year Storage
FA10	Dry Dam Detention 50-year Storage
MA1	Little Otter Creek Reservoir – Proposed Action
Combination of Alternatives	
FA11	Combination of Small Detention Structures and Dry Dam Detention 50-year Storage

*FA = Flood Damage Reduction Alternative; MA = Multipurpose Alternative

2.2.1 Alternative Screening Process

The alternatives were screened by comparing reasonable efforts necessary for the applicant to implement the project, while still meeting the purpose and need. Efforts to reduce flood damages in the affected stream reach looked at all areas in the watershed where peak-flow reduction or other measures resulted in reduced flood damages in the study area. Existing resources were used to compare impacts from alternatives considered. These included the NWI maps, 7.5-minute topographic maps, NRCS Soils Survey Map, USGS NHD, and aerial imagery. An AJD (USACE 2010) has been completed for the Proposed Action, but not for other alternatives. The AJD provides a higher level of detail through on-site verification and includes stream reaches at a larger scale than the NHD maps. Evaluation of alternatives and the Proposed Action will be based on the NWI and NHD maps to allow for an equal comparison.

The original hydraulic model that was created by the NRCS and used in the 2003 FEIS was modified and used to analyze the conveyance, levee, and valley encroachment alternatives. The channel size and levee elevations were set to meet the flood damage reduction goal for the project. The valley encroachment alternative was analyzed using unsteady flow analysis, which accounts for attenuation caused by storage volume filled behind the encroachment berms. Hydrologic models were also created to evaluate the conservation measures, 100-year dry dam, and small detention basin alternatives. For the 100-year dry dam alternative, the NRCS RESOP was used to calculate the size of the dry dam.

Average annual flood damages were calculated using the NRCS ECON2 model from the FEIS (USDA 1990). Normalized prices averaged the previous five years' actual market prices. Using the normalized prices, a discharge vs. damage curve was developed based on existing conditions. Flow reduction for each alternative was calculated and then applied to the damage curve to determine the damages for that alternative and frequency. For simplicity, flow reduction was compared at one location at the top of the reach. Average annual damages were calculated

by integrating the damage-frequency curve in Excel. For existing conditions, the average annual damage to cropland, roads, bridges, and fences is estimated to be $107,000.

2.2.2 Flood Damage Reduction Screening Criteria

Screening criteria for the alternatives analysis included substantially reducing annual flood damages in the study area. Substantial annual flood damage reduction is defined as reducing the annual damages by at least 60 percent and not increasing peak flows during the frequent flash flood storm events. The 60 percent threshold was selected to eliminate alternatives while allowing for evaluation of a reasonable range of alternatives.

The screening criteria narrow the range of alternatives to those that substantially reduce flood damages and meet the purpose and need. The criteria include the following:

A. Alternatives must provide substantial flood damage reduction.
    - This criterion is dependent on meeting the purpose of the project. Through a discussion with USACE and USEPA, the reasonable flood damage reduction threshold has been set at a 60 percent reduction to annual damages incurred by flooding within this study area (or at minimum an annual reduction of $64,200, which is 60 percent of $107,000).
B. Alternatives must comply with existing codes and regulations.
    - This criterion is reasonable for the logistics of alternative implementation. Existing codes and regulations are maintained by Caldwell County, the Missouri Department of Public Safety State Emergency Management Agency, and FEMA.
C. Alternatives must not increase the peak flows downstream.
    - Increasing peak flows could cause damages downstream. Alternatives that increase peak flows to reduce flood damages in the project area, but cause damages downstream, do not reduce the total flood damages.

The alternatives were screened by comparing reasonable efforts necessary for the applicant to implement the project and meet the purpose and need. Alternatives that meet the screening criteria will be evaluated for the multipurpose preferred alternative. Alternatives that do not meet the screening criteria are evaluated in the flood damage reduction combination of alternatives section. If an alternative can be combined with another alternative to meet the screening criteria, it will be further evaluated in the multipurpose preferred alternative.

2.2.3 Flood Damage Reduction Alternatives

No Action

If no action is taken, the land adjacent to Little Otter Creek will continue to flood regularly. The average annual damage to cropland, roads, bridges, and fences is estimated to be $107,000. Existing damages and degradation from flooding will continue and likely increase over time. This includes continued annual damages of $107,000, not accounting for inflation, or $10,700,000 over 100 years of the Proposed Action.

The No Action alternative does not provide flood damage reduction for the existing roads and bridges, utilities, or agricultural lands within the 100-year floodplain and, therefore, does not meet

the purpose and need for the project. This alternative is carried forward as a baseline for comparison.

Zoning (FA1)

This alternative would require action by the project proponent to adopt zoning regulations to prevent future development within the 100-year full build-out floodplain. However, Caldwell County participates in the National Flood Insurance Program, which requires that new structures be elevated above the base flood elevation and be kept reasonably safe from flooding. Zoning regulations would provide no additional protection that is not already provided by the floodplain regulations.

This option would not alleviate the current flooding and would not reduce the amount of flooding impacts to croplands and standing structures. This alternative does not meet the purpose and need to prevent flooding of existing agricultural lands and existing roads and bridges. Therefore, this alternative is not carried forward.

Floodplain Acquisition (FA2)

Information on land parcels obtained from geographic information system (GIS) databases was used to determine the acreage within the FEMA-mapped 100-year floodplain. This alternative would include acquiring 312 acres of cropland within the 100-year floodplain. This alternative would eliminate flood damages to cropland within the 3.8 miles of Little Otter Creek between Northeast Jefferson Drive and the confluence with Otter Creek, but it would not reduce damages to bridges. To accomplish this alternative, the applicant would need to acquire all 312 acres of land within the 100-year floodplain. This results in an annual flood damage reduction benefit of $86,000, or 81 percent reduction in total annual damages.

Floodplain acquisition does not increase flood flow downstream, and it reduces flood damages by 81 percent. Because this alternative meets the screening criteria, it will be further evaluated in the multipurpose evaluation section.

Conservation Measures (FA3)

Based on the likelihood that this watershed will be maintained for agricultural purposes for the foreseeable future, this alternative includes the utilization of best management practices (BMP), native plant buffers, and easements. Agricultural conservation practices such as no-till, buffer strips, grassed waterways, terraces, contour farming, and strip-cropping would be implemented. The conservation measures would be implemented on untreated agricultural lands and future developable lands within the Little Otter Creek drainage basin to reduce flood damages.

Benefits were determined by calculating the reduction in runoff caused by the implementation of conservation practices. The curve number method for calculating stormwater runoff correlates runoff to soils, land use, and conservation practices. The higher the curve numbers are, the greater the flood damages. The curve number is based on hydrologic soil group and land cover. Hydrologic soil group is a classification system that groups soils by their saturated hydraulic conductivity. The Little Otter Creek watershed is composed of soil groups C and D. Respectively, these soil groups represent soils with moderately high and high runoff potentials.

Meeting the screening criterion with this alternative is not feasible because the lowest possible achievable curve number does not meet the requirement of 60 percent reduction in annual

damages. Reducing the curve number sufficiently is not possible because the predominant soils in the watershed belong to hydrologic soil groups C and D. The flood damage reduction benefit was analyzed by looking at the lowest curve number that could be achieved with the soils that are present in the watershed. Implementing conservation BMPs in 100 percent of all lands in the watershed would only reduce the watershed curve number from 80 to 77, resulting in an average annual flood damage reduction benefit of $18,000 (about 17 percent) in the study area.

Landowners currently participating in conservation measures rely on the land for income through agricultural production. Market-driven cropland prices may result in the removal of conservation measures for increased cropland acreage. Because this alternative is completely voluntary, there is no guarantee that the conservation measures would be maintained. For example, the MDC estimates that 200,000 acres of Conservation Reserve Program (CRP) land were lost to contract expirations and land use conversions over a two-year period in a similar scenario relying upon voluntary landowner participation (MDC 2012).

To accomplish this alternative, the applicant would need to acquire all the land in the watershed, which is not reasonable. This alternative does not provide a 60 percent reduction in flood damages and is not carried forward to the multipurpose analysis. Because it is not reasonable to purchase all the land in the watershed or to rely entirely on voluntary landowner participation, this alternative is eliminated as a flood damage reduction combination alternative.

Wetland Storage Areas (FA4)

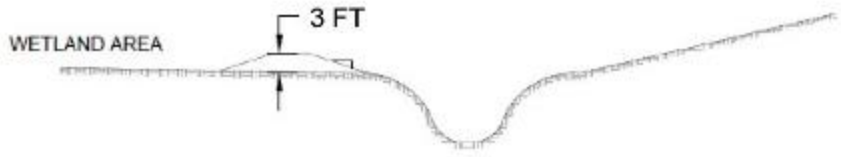
This alternative analyzed the watershed for the creation or restoration of wetland storage areas throughout the basin to reduce flood flows in Little Otter Creek. Constructed wetlands adjacent to the stream would serve as offline detention to effectively reduce the flood flows. It was determined—based on the allowable depth at 3 feet ponding—that 1,414 acres of wetlands would be needed to achieve flood damage reduction comparable to the applicant's project. The hilly topography precludes large areas of wetland development, and because of the incised streams, extensive excavations or impoundments would be needed to create wetlands. Additionally, based on the existing soil type and hydrology, very few lands in the watershed are conducive to wetland creation or enhancement.

Using hydric soils data from the NRCS, an estimated 255 acres were identified as containing hydric or predominantly hydric soils (at least 66 percent hydric inclusions) in the 4,825-acre drainage basin. All other mapped soil types are non-hydric or predominantly non-hydric (less than 33 percent hydric inclusions). If all 255 acres are converted to 3-foot basin wetlands, an average annual flood damage reduction benefit of $29,000, or 27 percent, could be achieved. Peak flow was estimated by modifying the existing conditions HEC-HMS model to represent the wetland storage basins in each watershed. This model assumed all the hydric soil areas were modified to 3-foot wetland basins. This alternative would achieve 100-year peak-flow reduction downstream.

Based on the NHD, NWI, and NLCD, this alternative would affect an estimated 11,830 feet of stream channel, 1.5 acres of wetlands, and 28.4 acres of upland forest. Although this alternative affects existing wetlands, this alternative would result in a net gain of created wetlands.

This alternative does not provide a 60 percent reduction in flood damages and will not be evaluated as a stand-alone alternative. However, this alternative would not increase peak flow

and will be evaluated further in the flood damage reduction combination of alternatives section. Figure 2.2.3-1 illustrates this alternative.



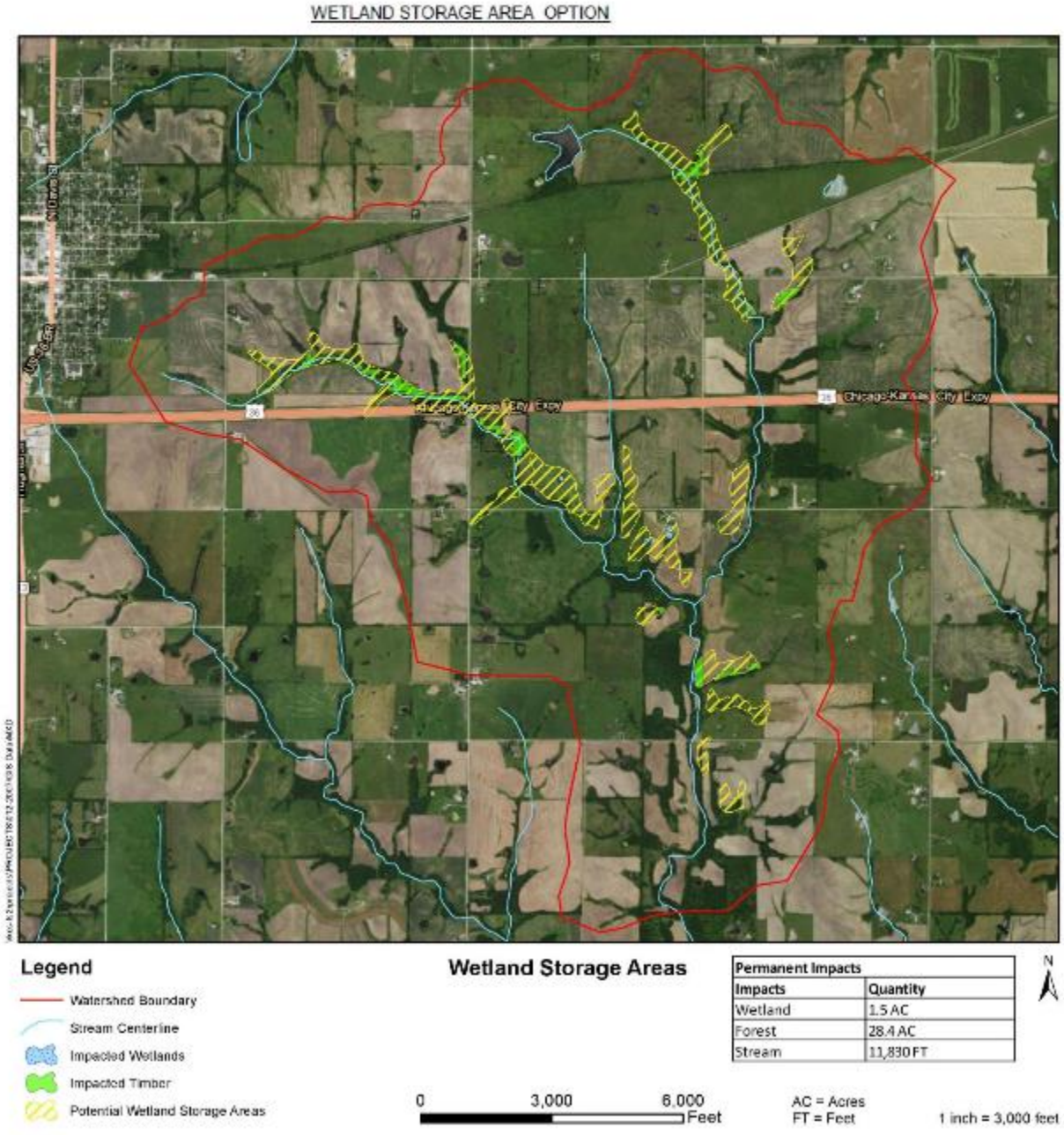


Figure 2.2.3-1. Wetland Storage Area Option.

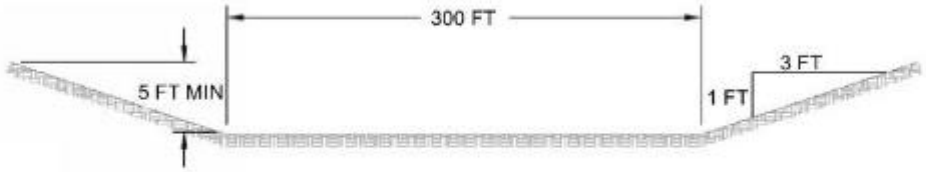
Conveyance (FA5)

This alternative would seek to eliminate flood damages by increasing the conveyance capacity (the ability of the channel to carry water within its banks) of Little Otter Creek to provide the projected 100-year flow for the affected reach. To provide the necessary conveyance for the 100-year flow, the channel cross-section must be 300 feet wide with 3:1 side slopes. Four bridges along the reach would also need to be widened to provide the necessary conveyance. This alternative would require the buyout of 146 acres of land for construction of a new channel. Figure 2.2.3-2 illustrates a concept of this alternative.

Conveyance would reduce 100 percent of the flood damages but would result in the change in land use of 47 acres of crop production within the new channel corridor. Average annual flood damage reduction benefit is estimated at $107,000; however, this alternative does not reduce peak flow in a timely manner.

Based on NHD, NWI, and NLCD, this alternative would affect an estimated 23,394 feet of stream channel, 27.8 acres of wetlands, and 71.5 acres of upland forest.

This alternative would reduce annual flood damages by greater than 60 percent (criterion A) and does not increase peak flows (criterion C). Note that this benefit is based on a conceptual plan. If more detailed design and analysis are done, it would likely be found that topography, soils, or other constraints would prevent the entire width of channel from being developed, or other hydrologic problems would be found that would reduce the benefits and even make this alternative not feasible. However, since the alternatives analysis is based on conceptual planning, this alternative is carried forward to the multipurpose section.



CONVEYANCE OPTION CHANNEL SECTION

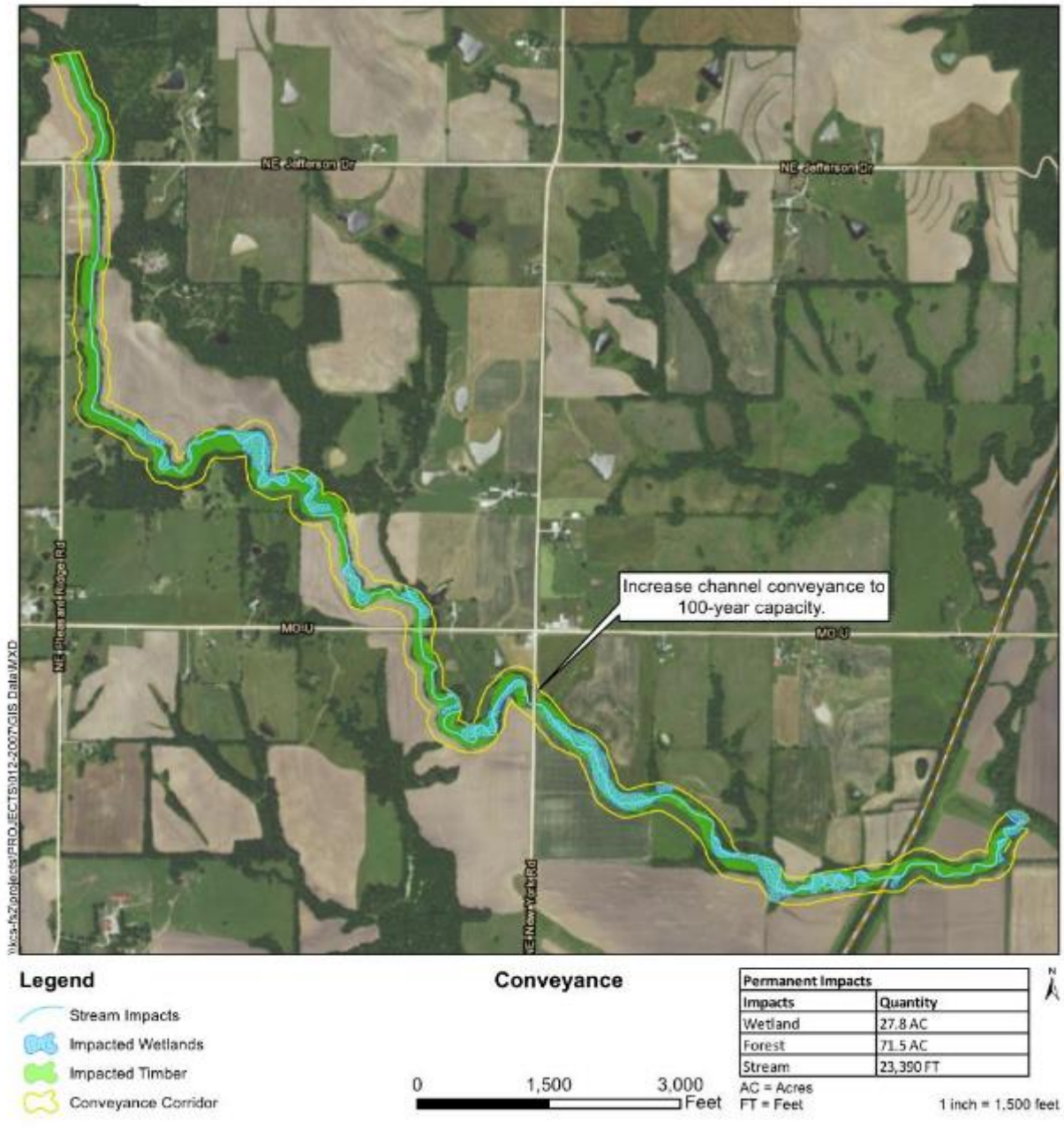


Figure 2.2.3-2. Conveyance Alternative.

Construct Levees and Raise Bridges (FA6)

This alternative would seek to eliminate flood damages by constructing earth-fill levees and raising existing bridges along Little Otter Creek in the study area. Figure 2.2.3-3 illustrates a concept of this alternative. The construction of 16-foot-tall levees would result in a change in land use for 254 acres of cropland and pasture from the floodplain. To construct the levees, the four bridges would need to be replaced. Flood damage reduction benefits include 100 percent damage reduction in the study area, which is an estimated benefit of $107,000.

Based on NHD and NWI, this alternative would result in the permanent loss of an estimated 550 feet of stream channel and 6.5 acres of wetlands. The upland forest impacts are based on the NLCD and are estimated to be 25.7 acres.

Although this alternative would result in a 100 percent reduction in flood damages, it would potentially increase peak flow. This alternative does not meet criterion C and is not carried forward as a stand-alone alternative. However, this alternative will be further evaluated in the flood damage reduction combination of alternatives.

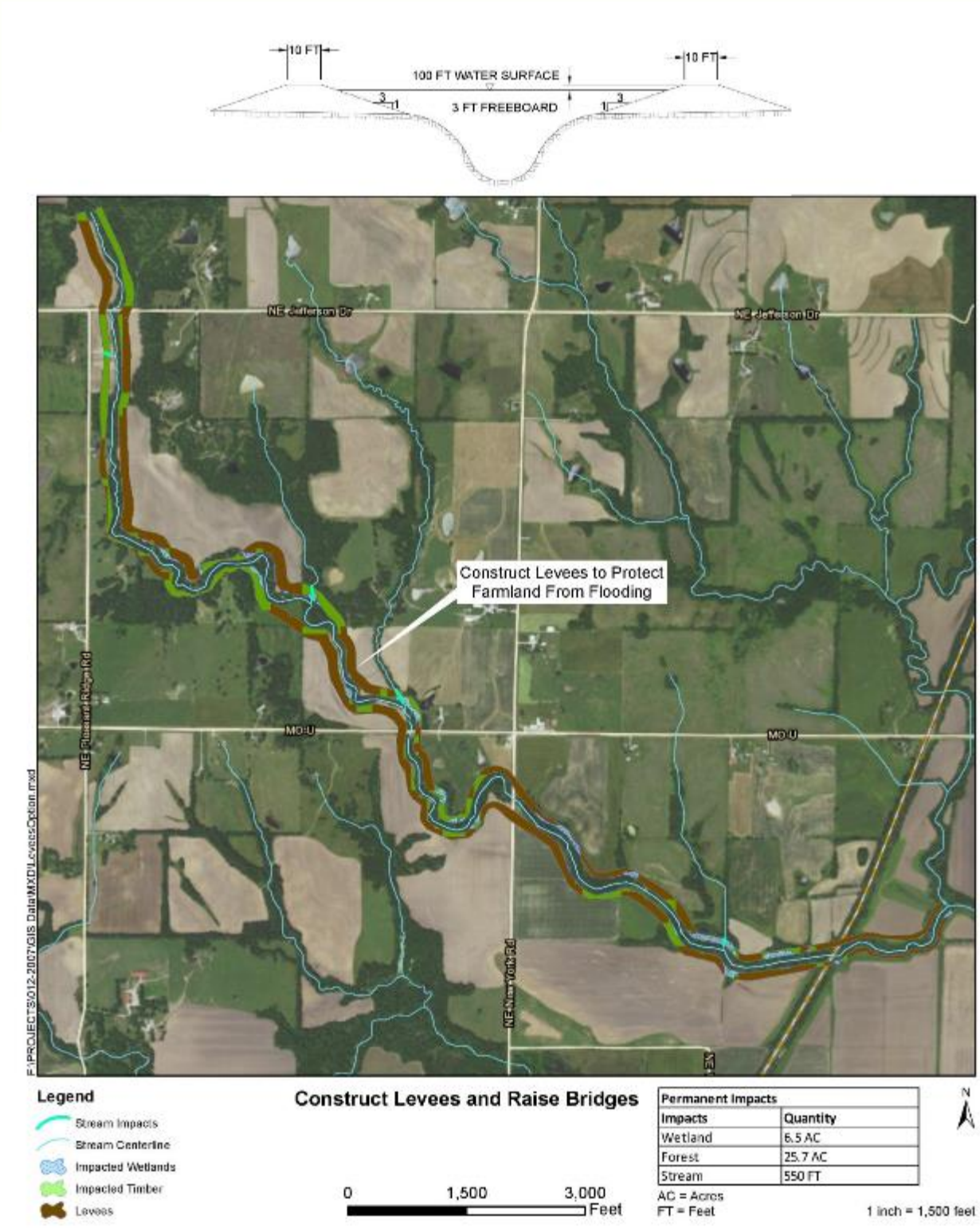


Figure 2.2.3-3. Construct Levees and Raise Bridges Alternative.

Valley Encroachment Berms (Alternative FA7)

This alternative would seek to provide flood damage reduction by constructing berms that would block flow from traveling downstream in the overbank areas. The berms would reduce peak flow rates by filling the overbank storage areas behind the berms. The valley-encroaching berms would be 5 feet tall and would be placed roughly every 1,000 feet. A total of 13 berms would be placed in the study area for optimal performance. Figure 2.2.3-4 illustrates a concept of this alternative.

Average annual flood damage reduction benefits were estimated at $4,000, or 4 percent. An unsteady flow hydraulic model was used to calculate the reduction in peak flow that could be achieved by this project and the resulting flood reduction benefits. Additional berms would provide little to no additional peak-flow reduction.

Based on the NHD, this alternative would result in the permanent loss of an estimated 30 feet of stream channel. Based on the NLCD, upland forest impacts are estimated to be 0.6 acre.

This alternative will not be evaluated as a stand-alone alternative because it does not meet the required flood damage reduction criterion. In addition, the narrow valleys and lack of floodplain storage strongly limit the effectiveness of this alternative, and it does not provide sufficient flood damage reduction to be combined with another alternative; as a result, it is eliminated from further consideration.

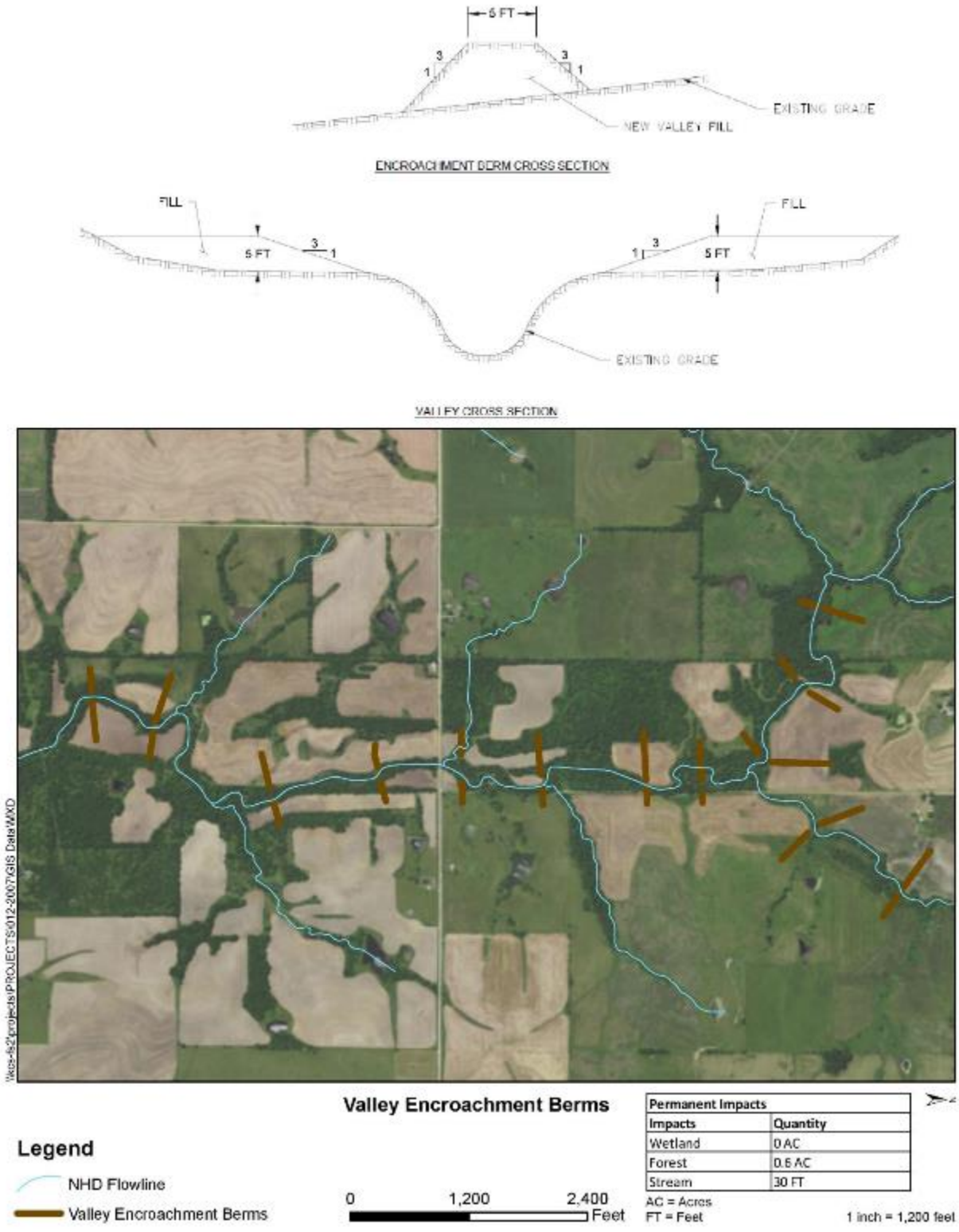


Figure 2.2.3-4. Valley Encroachment Berms.

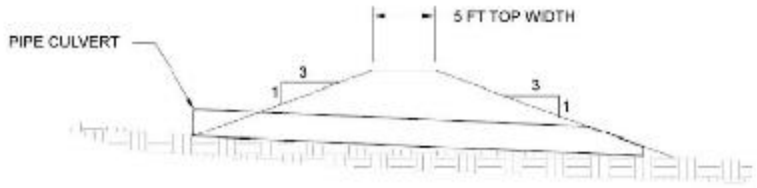
Small Detention Structures (Alternative FA8)

This alternative would seek to provide flood damage reduction by constructing a series of small detention structures to maximize flood storage and control upstream runoff. A total of 17 small detention structures were designed for optimal storage and flood damage reduction. These structures were conceptually designed as dry structures to reduce stream impacts. Figure 2.2.3-5 illustrates a concept of this alternative.

The HEC-HMS model estimated flow rates at the top of the flood reduction area, and it was determined that the detention structures would intercept runoff from an estimated 42 percent of the watershed and reduce peak flow rates from the existing condition. Using ECON2 to analyze these flows from HEC-HMS, the average annual flood damage reduction benefit was estimated at $38,000, or 36 percent. The detention structures were designed to have a life span of 100 years.

Based on the NHD, this alternative would result in the loss of an estimated 1,550 feet of stream channel. Based on the NLCD, upland forest impacts are estimated to be 1 acre. The small detention structures alternative provides 35 percent flood damage reduction.

This alternative will not be evaluated as a stand-alone alternative because it does not meet the required flood damage reduction criterion. This alternative will be further evaluated in the combination of alternatives section.



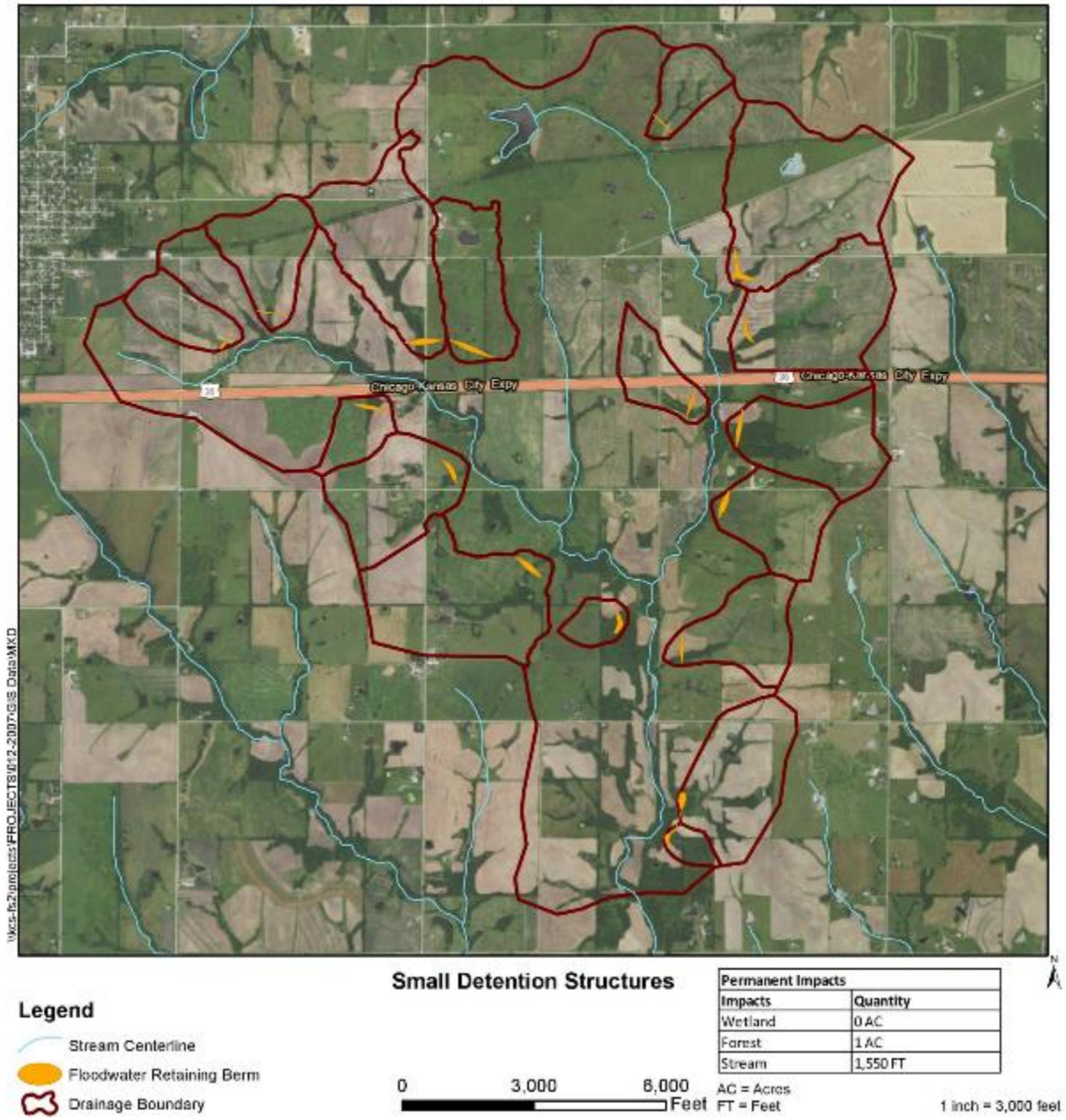


Figure 2.2.3-5. Small Detention Structures.

Dry Dam Detention 100-year Storage (Alternative FA9)

This alternative was designed to hold a 100-year volume of runoff at the depth of the spillway and includes the construction of an embankment solely for flood damage reduction at the location of the Proposed Action. Figure 2.2.3-6 illustrates a concept of this alternative. The dam under this alternative would be like the dam designed for the Proposed Action but on a smaller scale with no permanent water storage. The top-of-dam elevation is estimated at 848 feet, or 24 feet lower than that of the Proposed Action's top of dam. The dam location is the same as that for the Proposed Action and was selected to provide flood damage reduction benefits to the downstream areas where the flood damages are occurring.

This alternative would reduce the 100-year peak flow by 95 percent and would provide an average annual flood damage reduction benefit of $101,000, or 95 percent.

Based on NHD and NWI, this alternative would result in the permanent loss of an estimated 450 feet of stream channel and 0.4 acre of wetlands. Based on the NLCD, upland forest impacts are estimated at 3.6 acres.

This alternative meets the flood damage reduction criterion and is carried forward to the multipurpose section.

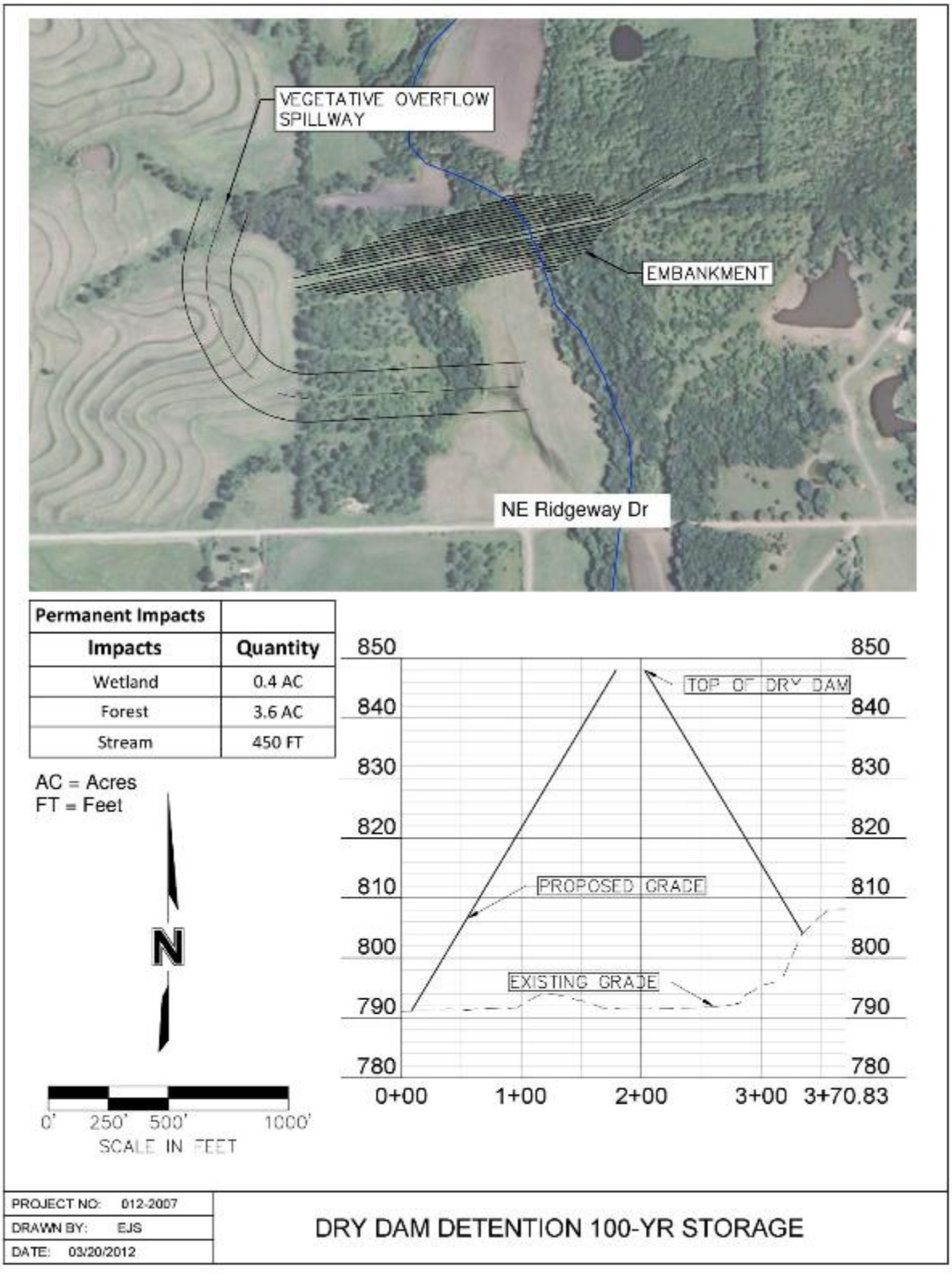


Figure 2.2.3-6. Dry Dam Detention 100-year Storage.

Dry Dam Detention 50-Year Storage (Alternative FA10)

This alternative includes the construction of an embankment solely for flood damage reduction. Figure 2.2.3-7 illustrates a concept of this alternative. The dam would be like the dam designed for the Proposed Action but much smaller and with no permanent water storage. The dam location is the same as that for the Proposed Action and was selected to provide flood damage reduction benefits to the downstream areas where the flood damages are occurring. The dry dam could store the 50-year event without use of the spillway. All 100-year flows would discharge through a concrete chute spillway. The top-of-dam elevation is estimated at 830 feet, or 18 feet lower than the 100-year dry dam option.

Average annual flood damage reduction benefits are estimated at $57,000. This alternative would reduce 100-year peak flow and would reduce average annual flood damage by an estimated 54 percent.

Based on the NHD and NWI, this alternative would result in the permanent loss of an estimated 230 feet of stream channel and 0.4 acre of wetlands. Based on the NLCD, upland forest impacts are estimated at 2 acres.

This alternative does not meet the flood damage reduction criterion A and is not carried forward as a stand-alone alternative. This alternative will be further evaluated in the combination of alternatives section.

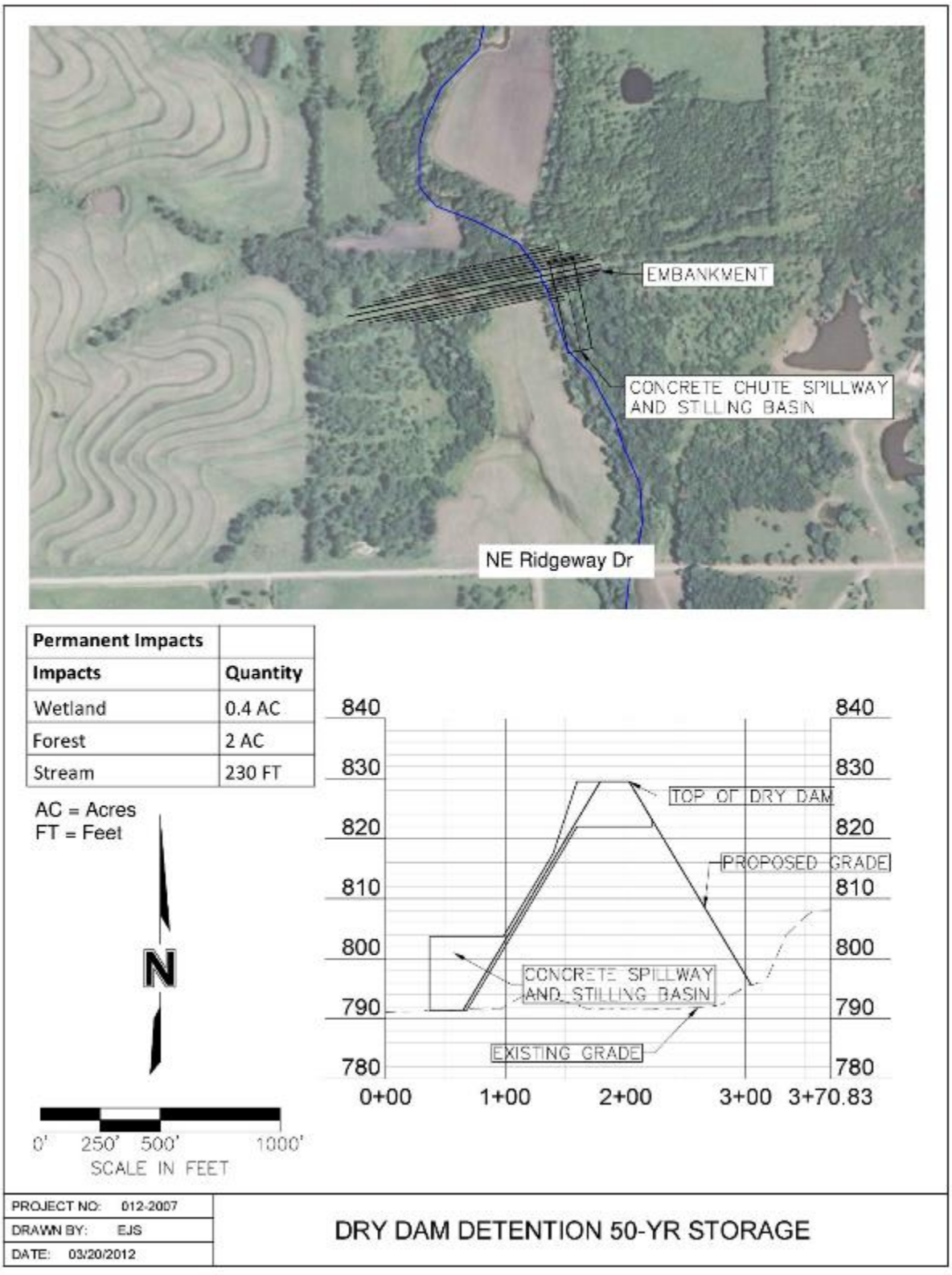


Figure 2.2.3-7. Dry Dam Detention 50-Year Storage.

Little Otter Creek Reservoir – Proposed Action (MA 1)

The Proposed Action provides water supply, flood damage reduction benefits, and water-based recreation opportunities. The Proposed Action is described in more detail in Section 2.1.2.5 Creation of a New Reservoir.

The Proposed Action provides $89,700 in annual flood damage reduction benefits, an 84 percent reduction, and meets the flood damage reduction screening criteria. The environmental impacts of the Proposed Action include 25,540 feet of NHD streams, 6.6 acres of NWI wetlands, and 97.6 acres of NLCD forest.

2.2.4 Summary of Flood Damage Reduction Alternatives Screening Process

Table 2.2.4-1 summarizes the individual flood damage reduction alternatives and whether or not they meet all the screening criteria. The No Action alternative is carried forward as the baseline comparison. The alternatives that did not meet the screening criteria and are not considered in the combination of alternatives are highlighted in red. The alternatives that met at least one screening criterion are further evaluated in the combination of flood damage reduction alternatives.

Table 2.2.4-1. Summary of Flood Damage Reduction Alternatives Screening.

Alternative	Meets Criteria (Y/N)	Screening Criteria		
		Criterion A 60 Percent Flood Damage Reduction (percent)	Criterion B Comply with Existing Codes and Regulations	Criterion C No Increase for Peak Flow
No Action Alternative	N	N	Y	N
FA1. Zoning	N	N	Y	N
FA2. Floodplain Acquisition	Y	81	Y	Y
FA3. Conservation Measures	N	17	Y	Y
FA4. Wetland Storage Areas	N	27	Y	Y
FA5. Conveyance	N	100	Y	N
FA6. Construct Levees and Bridges	N	100	Y	N
FA7. Valley Encroachment Berms	N	4	Y	N
FA8. Small Detention Structures	N	36	Y	Y
FA9. Dry Dam Detention 100-year Storage	Y	95	Y	Y
FA10. Dry Dam Detention 50-Year Storage	N	54	Y	Y
MA1. Little Otter Creek Reservoir – Proposed Action	Y	84	Y	Y

2.2.5 Flood Damage Reduction – Combination of Alternatives

The floodplain acquisition, proposed action, and dry dam detention 100-year storage alternatives meet the flood damage reduction screening criteria and will be evaluated in the multipurpose analysis.

The remaining alternatives do not meet screening Criterion A (60 percent reduction in flood damages) or screening Criterion C (no increase in peak flow) but were evaluated to see whether they could meet criteria when combined with other alternatives.

Alternatives were considered as possible flood damage reduction combination alternatives if they provided some flood damage reduction benefit and didn't increase peak flow, or depth, velocity, duration, or frequency of flooding downstream. The No Action alternative and the zoning alternative were not considered as possible flood damage reduction combination alternatives, since they did not provide any flood damage reduction benefit. The conservation measures alternative was not considered because it is not reasonable to apply conservation measures on all the property within the watershed and the benefits are limited by the runoff potential of the soils in the watershed. The valley encroachment berms alternative did not provide sufficient flood damage reduction benefits or mitigation of peak flows to be combined with the other alternatives to meet the 60 percent threshold or mitigation of peak flows in a timely manner.

The list of alternatives that could be considered for a combination alternative include:

- Wetland Storage Areas (FA4)
- Conveyance (FA5)
- Construct Levees and Raise Bridges (FA6)
- Small Detention Structures (FA8)
- Dry Dam Detention 50-Year Storage (FA10)

These six alternatives could be combined in many potential ways. To simplify the process, the combination of flood damage reduction alternatives that could provide at least 60 percent in flood damage reduction with the fewest environmental impacts to streams, wetlands, or forests will be further considered for the multipurpose analysis.

Combination of Small Detention Structures and Dry Dam Detention 50-Year Storage Alternatives (FA11)

A combination of small detention structures and dry dam detention 50-year storage would provide an estimated 89 percent in flood damage reduction and would result in the fewest combined environmental impacts. Table 2.2.5-1 summarizes benefits and impacts of this alternative.

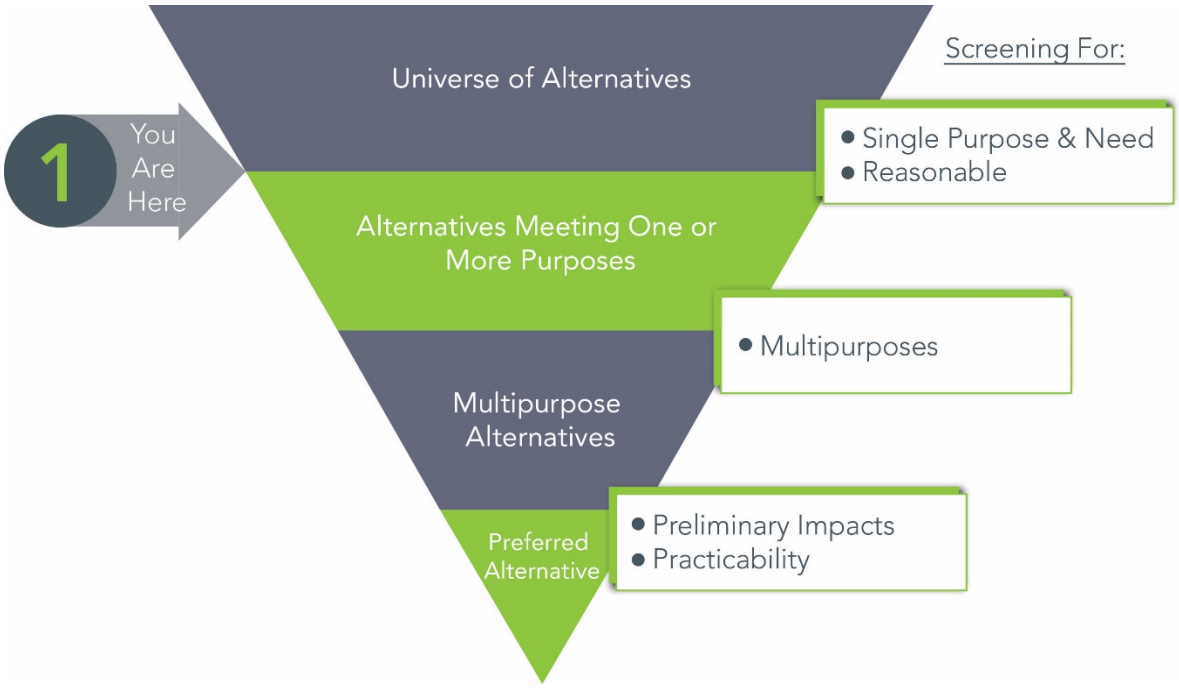
Table 2.2.5-1. Combination of Small Detention Structures and Dry Dam Detention 50-Year Storage Alternatives (FA11).

Alternative	Flood Damage Reduction (percent)	Permanent Wetland Impacts (acres)	Permanent Stream Impacts (feet)	Permanent Upland Forest Impacts (acres)
Small Detention Structures	35	0	1,550	1
Dry Dam Detention 50-Year Storage	54	0.4	230	2
TOTALS	**89**	**0.4**	**1,780**	**3**

2.3 Water-Based Recreation Alternatives Analysis

The list of water-based recreation alternatives was developed after determining the recreation project purpose, which is stated as: Provide water-based recreation to help meet the unmet demand for Caldwell County and 25-mile radius Recreation Market Area (RMA, Section 1.2 Project Purpose and Need for Action). The RMA where recreation is needed has been identified as a 25-mile radius around the Proposed Action (study area; Figure 2.3-1).

All user-days have been calculated consistent with the methodology used in the 2003 FEIS. As described in the purpose and need section, there is a demand of 230,000 annual user-days within the RMA and a supply of 130,000 annual user-days. The unmet demand was calculated by subtracting the recreation supply from the recreation demand. The total unmet demand within the study area is 100,000 annual user-days. To meet the purpose and need, alternatives must be able to provide recreation to help meet the unmet demand within the 25-mile radius of the RMA. The list of alternatives was developed after determining the project purpose of providing 45 percent of the unmet demand for water-based recreation, or 45,000 annual user-days.



This section screens the universe of water-based recreation alternatives.

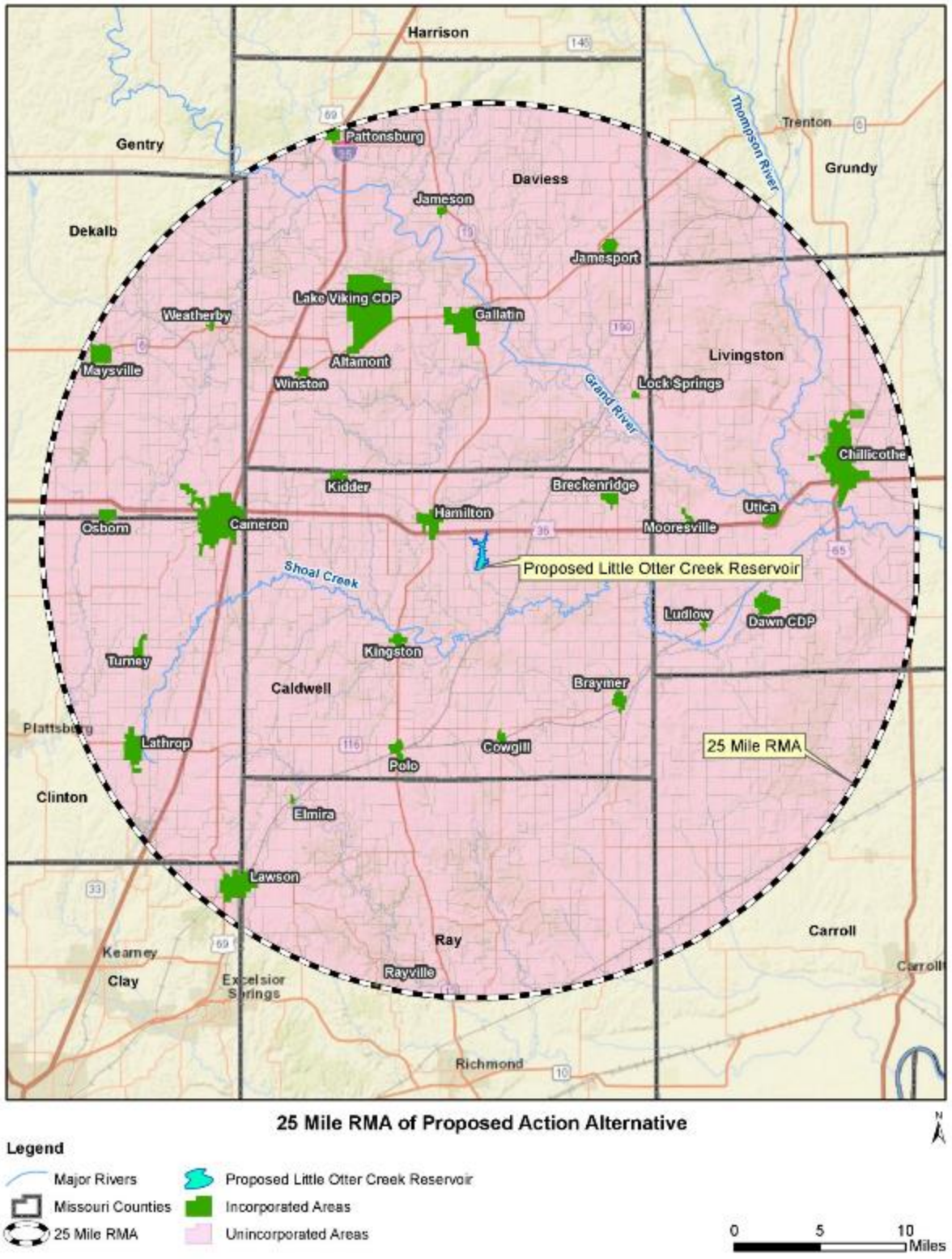


Figure 2.3-1. 25 Mile Radius RMA of the Proposed Little Otter Creek Reservoir.

The water-based recreation alternatives for consideration are listed in Table 2.3-1.

Table 2.3-1. Recreation Alternatives.

	No Action Alternative
RA1	Create Stream Access
RA2	Expand and Improve Existing Private Lake Access
RA3	Develop a Series of Ponds
Alternative Reservoir Locations	
MA1	Little Otter Creek – Proposed Action
DPA1	Alternative Reservoir Location – Site 2
DPA2	Alternative Reservoir Location – Site 3
DPA3	Alternative Reservoir Location – Site 4
DPA4	Alternative Reservoir Location – Site 5
Combination of Alternatives	
RA4	Combination of RA1 and DPA2

2.3.1 Screening Criteria

Screening criteria for the alternatives analysis recognized the best opportunity to provide water-based recreational opportunities in the study area. The results of the 2003 FEIS indicated a fishing demand totaling 230,000 annual user-days with a total fishing supply of 130,000 annual user-days. Based on the 2003 FEIS, there is an unmet demand for 100,000 annual user-days for fishing. As noted in the purpose and need, no changes have occurred to recreational facilities since the 2003 FEIS was completed.

Criteria were developed to evaluate alternatives. The criteria for providing water-based recreation were developed to achieve a significant reduction in unmet demand but also allow for analysis of a reasonable range of alternatives. The water-based recreation criteria are listed below.

A. Alternatives must meet or exceed 45 percent of the unmet demand for water-based recreation user-days.
    - This criterion is dependent on meeting or exceeding 45 percent of the unmet user-day demand (45,000 user-days) for adequate water-based recreation opportunities.
B. Alternatives must comply with existing codes and regulations.
    - This criterion is reasonable for the logistics of alternative implementation.
C. Alternatives must be available for public use and have public access.
    - This criterion requires public ownership and reasonable parking and walking lanes for access to the water-based recreation.

Water-Based Recreation Analysis

The alternatives were screened by comparing reasonable efforts necessary for the applicant to implement a project that meets the purpose and need. Alternatives that individually meet the water-based recreation screening criteria are evaluated for the multipurpose analysis. Alternatives that do not individually meet the screening criteria are evaluated in the water-based recreation combination of alternatives section. If an alternative can be combined with another alternative to meet the screening criteria, it will be further evaluated for the multipurpose analysis.

Alternatives are eliminated from consideration if they cannot individually or in combination with another alternative meet the screening criteria.

Environmental impacts for each alternative were developed by reviewing publicly available NHD, NWI, and NLCD data to determine the potential impacts to wetlands, waters, and forest areas for each water supply alternative.

The methodology of the 2003 FEIS was used to determine the amount of recreational opportunities that would be provided by alternatives. The 2003 FEIS calculated supply based on lake acreage, which was determined to be 166 user-days per lake-acre per year. Because no change has occurred since the 2003 FEIS, this SEIS assumes 166 user-days per acre per year for calculating supply for new lakes.

The 2003 FEIS did not mention a standard method for determining stream access supply; therefore, stream access supplied by alternative RA1 is based on data provided in the 2013 Missouri Statewide Angler Survey (MDC 2016a). According to the 2013 angler survey, the Grand River had an estimated 63,315 angler days in 2013. For the analysis for this SEIS, where fishing is the main recreational benefit of alternatives, “angler day” is considered to be the same as “user-day.”

There are 13 stream access points along the Grand River in the state of Missouri (MDC 2017a). Dividing 63,315 user-days by the number of stream access points gives an average of 4,870 user-days per year per access point. Stream access parking standards were determined based on the average number of existing spaces at existing MDC access points, which is 10 parking spaces per access point.

2.3.2 Water-Based Recreation – Alternatives Considered

No Action Alternative

The No Action alternative does not provide an opportunity for water-based recreation. No significant change in the amount of public or private recreational area is expected without the project. The community’s desire for additional recreational development will not be addressed. Although this alternative does not meet the project purpose and need for recreation, it is carried forward as a baseline for comparison.

Create Stream Access (RA1)

This alternative would include creating access to water-based recreation by acquiring private land and constructing parking at various locations along the Grand River and the Thompson River, within the 25-mile RMA. The Grand and Thompson rivers are the largest streams in the 25-mile project study area. Shoal Creek is also within the RMA; however, it is not suitable for water-based recreation, because it is too narrow and shallow. Based on review of aerial photographs, the average width of Shoal Creek is 50 feet, compared to over 200 feet for the Grand and Thompson rivers. As an indication of suitability for recreation, MDC has access points on the two rivers, but it does not have any stream access points along Shoal Creek within the 25-mile project study area.

To determine how many access points could be added, the typical number of existing MDC access points per county was determined to help indicate optimal access for people interested in

fishing from streams. Caldwell County and the surrounding counties have an average of three existing stream access points per county, with a range of zero to six stream access points, depending on location. For optimal access for those interested in fishing from streams in Caldwell County, based on its size, the RMA should have nine access points. Six access points already exist; therefore, three more should be added (Figure 2.3.2-1). Each point chosen provides feasible access from a road that is easily accessible to the public. Points were selected no less than 2 miles from each other or from the designated MDC access points. Creating new stream access will require the purchase of land at each of the three access points. The land will be used for developing parking and river access from the parking area to the river bank.

In addition, land access along the river itself was considered essential for legal use of the river. According to Missouri law (*Elder v. Delcour* 1954), any person has a right to move upstream or downstream in the water; however, the landowner controls the right of access from the bank to the creek. Users would not be able to move up and down the Grand and Thompson rivers without an easement to allow for public access beyond the parking area and pathway to the river bank.

Based on the data presented in the 2013 Missouri Statewide Angler Survey (MDC 2016a), it was determined that on average, access points along the Grand River have an estimated 4,870 annual user-days. Providing an additional three access points in Caldwell County, as identified in Figure 2.3.2-1, would potentially provide an additional 14,610 annual user-days (or 15 percent of the unmet user-day demand).

Based on NHD and NWI, this alternative would result in the permanent loss of an estimated 0 feet of stream channel and 0 acre of wetlands. Based on the NLCD, upland forest impacts are estimated at 0.1 acre.

This alternative does not meet screening criterion A. and is not considered as a stand-alone alternative; however, this alternative could provide 14,610 annual user-days and will be evaluated in the water-based recreation combination of alternatives.

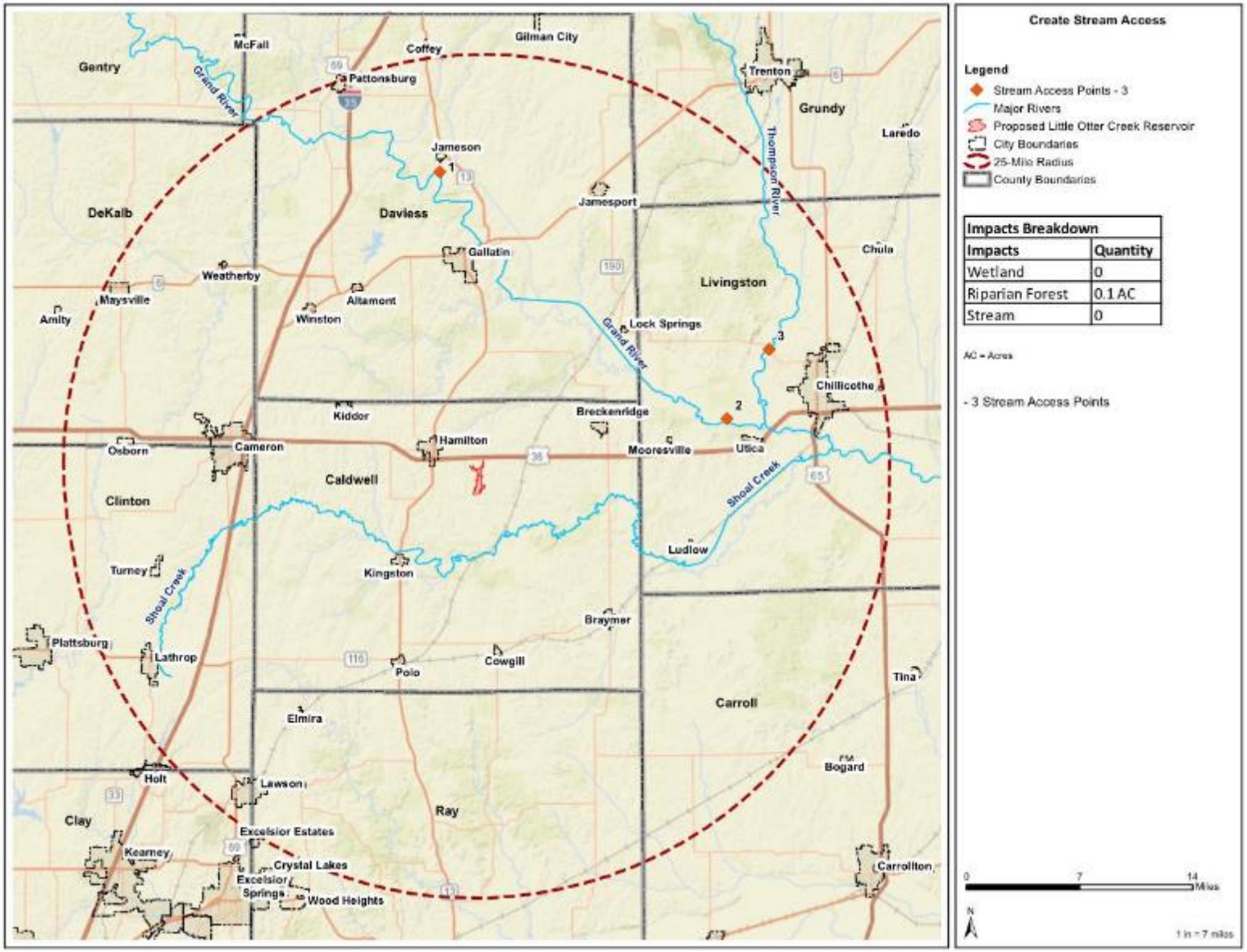


Figure 2.3.2-1. Create Stream Access (RA1).

Expand and Improve Access to Existing Private Lakes (RA2)

This alternative would include expanding access to private lakes within the 25-mile radius of the Little Otter Creek study area. Two private, residential lakes were identified within the 25-mile radius study area: Lake Viking (630 acres) and Lake Arrowhead (95 acres). These two lakes do not currently provide public use. Based on the acreage of the lakes, an estimated 120,350 user-days could be provided annually (166 user-days per acre of lake); however, because the lakes are privately owned, they are not available for public use and not anticipated to become available for public use in the future.

Evaluation of smaller private lakes and ponds within the 25-mile RMA revealed 152 ponds and lakes over 5 acres that totaled 1,603 acres. The average size of private ponds and lakes was 10.5 acres. Based on the acreage of the ponds and lakes, 266,098 user-days could be provided annually. Because the ponds and lakes are on private lands and few, if any, landowners would be willing to grant public access, it is not feasible to achieve the necessary user-days for public access in this way.

MDC created the Missouri Outdoor Recreational Access Program (MRAP) to increase outdoor recreational opportunities on private land (MDC 2016b). The program received funding in 2014 and has been operational for three years. There are no lakes or ponds within the 25-mile RMA currently enrolled in the MRAP (MDC 2016b). While more lakes and ponds may be enrolled in the future, the current data shows no interest in enrolling private lakes into public access within the RMA.

This alternative does not meet criterion C and is not carried forward. Since there is no guarantee that this alternative would provide public access and use, it is eliminated from further consideration.

Develop a Series of Ponds (RA3)

This alternative would develop a series of ponds to provide water-based recreation for the study area. Fifteen sites were identified as suitable locations by looking at the topography and stream networks in the 25-mile RMA radius and finding locations that were not already encumbered with existing, private uses. However, this configuration of sites is one example and could be reconfigured in a variation of the 15 locations. Pond sites could be located to avoid impacts to wetlands and forest; however, to maintain a viable fishing pond, stream impacts would be unavoidable. Pond size was determined based on the average size of nearby MDC ponds (5 acres) and would be constructed similar to MDC ponds. NRCS pond construction design standards recommend a pond be at least 8 feet deep for Missouri (NRCS 1997). An 8-foot-deep, 5-acre pond correlates to 16 acre-feet of water. To attain 16 acre-feet of water in the precipitation zone of Caldwell County, a 96-acre watershed would be needed (NRCS 1997). A simple review of streams in Caldwell County shows stream formation in watersheds smaller than 96 acres. Figure 2.3.2-2 illustrates a concept of this alternative.

Using the standard of 166 annual user-days per acre from the 2003 FEIS, this alternative would provide an estimated 15,936 annual user-days.

Based on NHD and NWI, this alternative would result in the permanent loss of an estimated 13,450 feet of stream channel and 0 acre of wetlands. Based on the NLCD, upland forest impacts are estimated at 0 acres.

This alternative does not meet screening criterion A and is not considered as a stand-alone alternative; however, this alternative could provide 15,936 annual user-days. This alternative will be evaluated in the water-based recreation combination of alternatives.

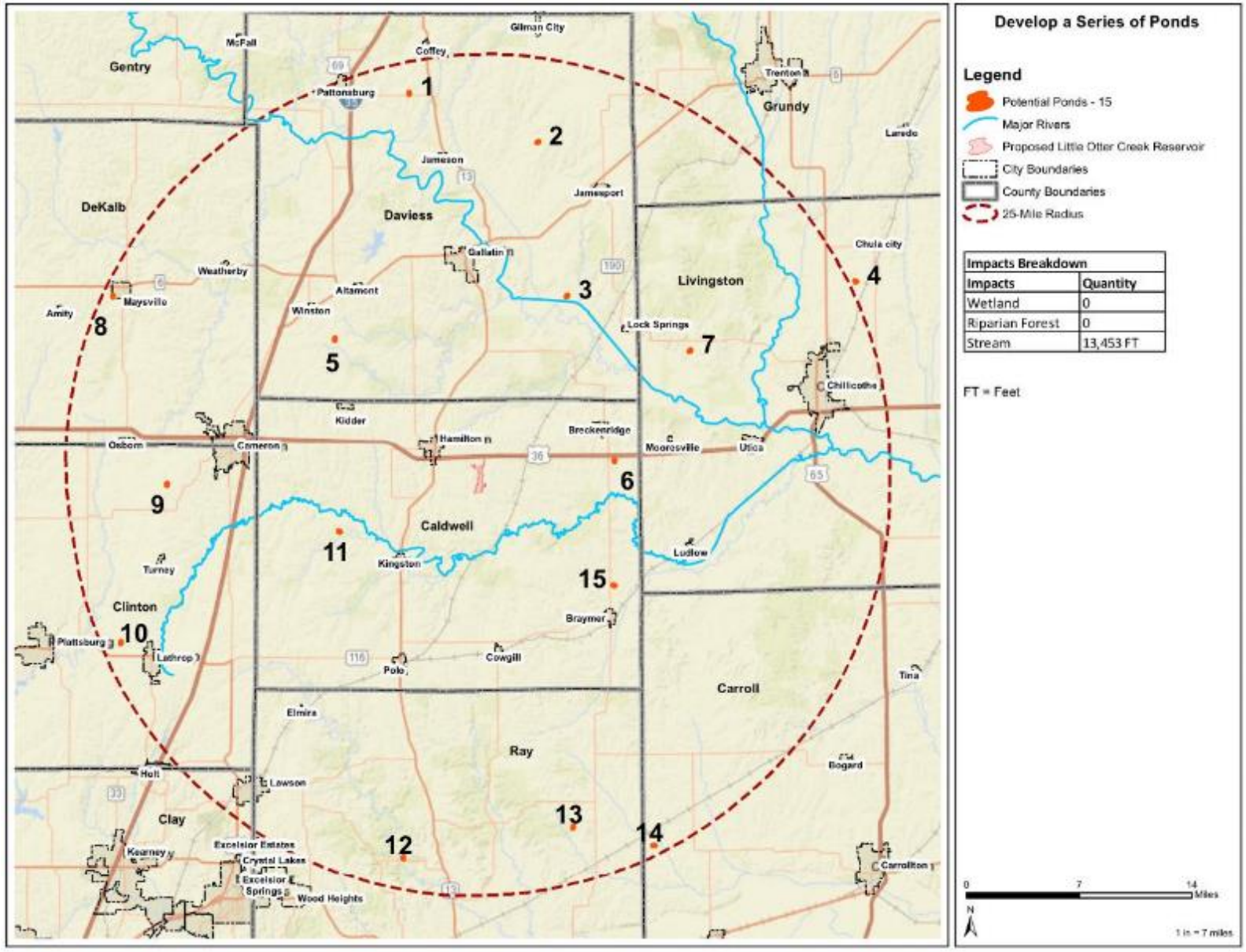


Figure 2.3.2-2. Develop a Series of Ponds (RA3).

Alternative Reservoir Locations

As part of the Shoal Creek Basin Feasibility Study (USDA-SCS 1991), the NRCS evaluated five reservoir locations, including the Proposed Action, which is the Little Otter Creek Reservoir (MA1). The other four reservoir locations evaluated in the study are identified on Figure 2.3.2-3. Because all reservoir alternatives are in the same general area, it is assumed that all would have similar climate, land use, and hydrologic characteristics. These alternative reservoir locations were only evaluated at a feasibility study level, so full environmental impacts were not quantified in the 1991study.

The alternative locations will be evaluated to the same level as the other alternatives presented in this SEIS to determine whether they can be carried forward for the multipurpose analysis.

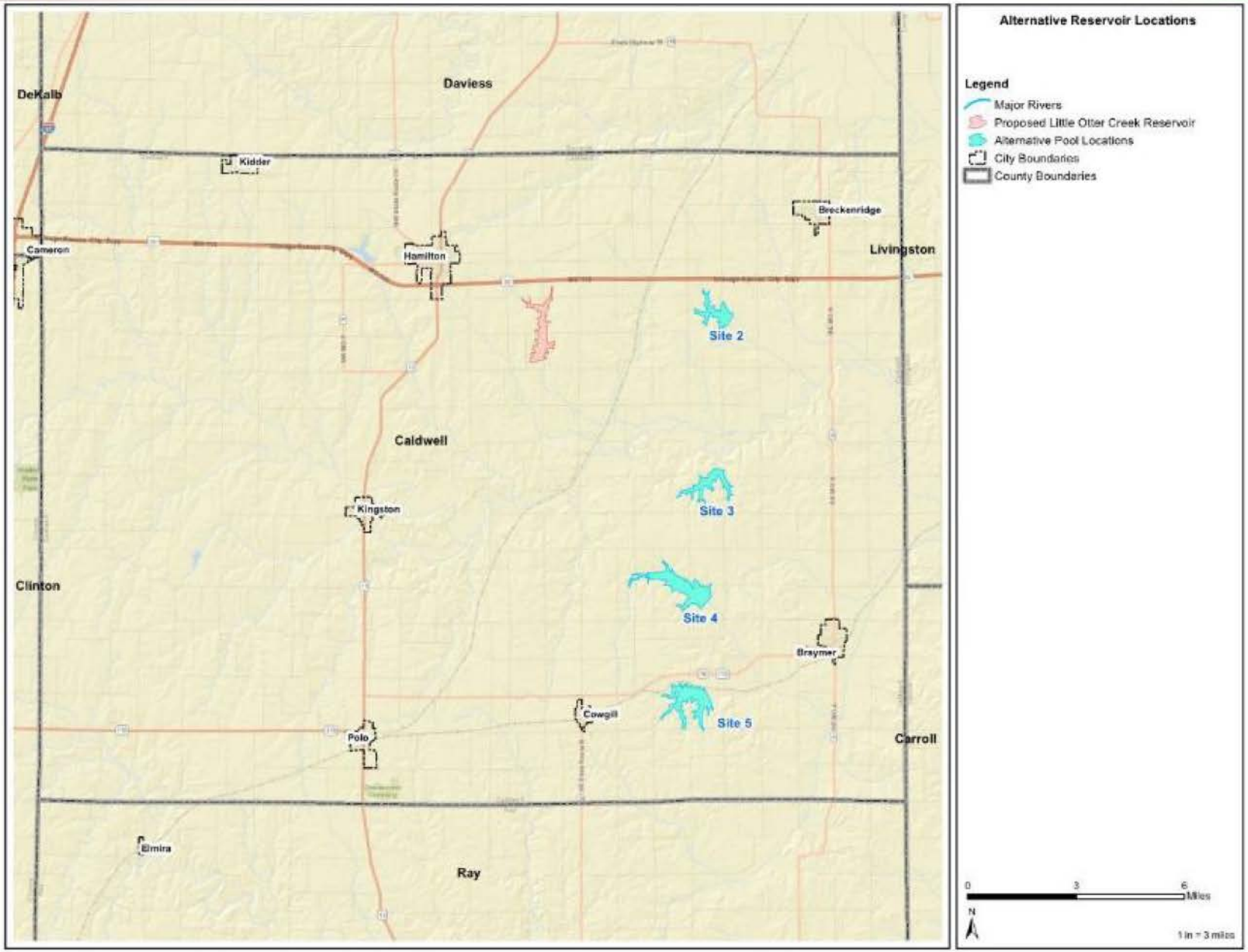


Figure 2.3.2-3. Alternative Reservoir Locations.

Little Otter Creek Reservoir – Proposed Action (MA1)

The Proposed Action provides water supply, flood damage reduction benefits, and water-based recreation opportunities. Based on the standard of 166 annual user-days per acre used in the 2003 FEIS, the Proposed Action would provide an estimated 57,104 annual user-days. The Proposed Action is described in Section 2.1.2.5 Creation of a New Reservoir.

Alternative Reservoir Location – Site 2 (DPA1)

Alternative Reservoir Location – Site 2 provides water supply and water-based recreation opportunities. The Alternative Reservoir Location – Site 2 would provide 36,188 annual user-days of recreation. This alternative does not meet screening criterion A for water-based recreation and is not carried forward as a stand-alone alternative but will be evaluated in the combination of water-based recreation alternatives. Alternative Reservoir Location – Site 2 is described in Section 2.1.2.5 Creation of a New Reservoir.

Alternative Reservoir Location – Site 3 (DPA2)

Alternative Reservoir Location – Site 3 provides water supply and water-based recreation opportunities. The Alternative Reservoir Location – Site 3 would provide 38,678 annual user-days of recreation. This alternative does not meet screening criterion A for water-based recreation and is not carried forward as a stand-alone alternative but will be evaluated in the combination of water-based recreation alternatives. Alternative Reservoir Location – Site 3 is described further in Section 2.1.2.5 Creation of a New Reservoir.

Alternative Reservoir Location – Site 4 (DPA3)

Alternative Reservoir Location – Site 4 provides water supply and water-based recreation opportunities. The Alternative Reservoir Location – Site 4 would provide 81,838 annual user-days of recreation. This alternative meets the screening criteria for water-based recreation and is carried forward for multipurpose analysis. Alternative Reservoir Location – Site 4 is described further in Section 2.1.2.5 Creation of a New Reservoir.

Alternative Reservoir Location – Site 5 (DPA4)

Alternative Reservoir Location – Site 5 provides water supply and water-based recreation opportunities. The Alternative Reservoir Location – Site 5 would provide 70,882 annual user-days of recreation. This alternative meets the screening criteria for water-based recreation and is carried forward for multipurpose analysis. Alternative Reservoir Location – Site 5 is described further in Section 2.1.2.5 Creation of a New Reservoir.

2.3.3 Water-Based Recreation Combination of Alternatives

Alternatives that are not available for public use (criterion C) do not meet the purpose and need and cannot be met by combining alternatives. However, screening criterion A is based on providing 45,000 recreation user-days and can be achieved by combining alternatives.

Alternatives that did not meet the screening criteria were evaluated as a water-based recreation combination alternative. Alternatives that can be combined to meet the screening criteria will be further evaluated in the multipurpose analysis.

The following alternatives did not meet the screening criteria and will be evaluated as a combination alternative:

- Create Stream Access (RA1)
- Develop a Series of Ponds (RA3)
- Alternative Reservoir Location – Site 2 (DPA1)
- Alternative Reservoir Location – Site 3 (DPA2)

Table 2.3.3-1 summarizes the results of the screening criteria for the alternatives considered for the combination of alternatives.

The No Action alternative and the Expand and Improve Existing Private Lake Access alternative cannot be combined to provide additional user-days since they do not meet screening criterion C.

These four alternatives could be combined in many potential ways. To simplify the process, the combination of water-based recreation alternatives that could provide at least 45,000 user-days with the fewest environmental impacts to streams, wetlands, or forests will be further considered for the multipurpose analysis. This analysis eliminated RA3 and DPA2 from the combined alternatives.

Combination of Alternative Reservoir Location – Site 3 and Create Stream Access (RA4)

A combination of Alternative Reservoir Locations – Site 3 and Create Stream Access would meet the recreational criteria, and it is carried forward for multipurpose analysis as RA4. Table 2.3.3-1 summarizes benefits and impacts of this alternative

Table 2.3.3-1. Combination of Create Stream Access and Alternative Reservoir Location – Site 3 (RA4).

Alternative	Additional User-days Provided	Permanent Wetland Impacts (acres)	Permanent Stream Impacts (feet)	Permanent Upland Forest Impacts (acres)
Create Stream Access	14,610	0.0	0.0	0.1
Alternative Reservoir Location – Site 3	38,678	3.9	23,600	196
Combination Totals	**53,288**	**3.9**	**23,600**	**196.1**

2.3.4 Summary of Water-Based Recreation Alternatives.

Table 2.3.4-1 summarizes all the individual and combined water-based recreation alternatives and whether they met all the screening criteria. Alternatives that meet the screening criteria for the water-based recreation purpose and need are indicated in green and are carried over for further analysis in the multipurpose analysis. The No Action alternative is carried forward as the baseline comparison. The alternatives that did not meet the screening criteria and are not considered in the combination of alternatives are highlighted in all red.

Table 2.3.4-1. Summary of Water-Based Recreation Alternatives.

Alternative	Meets Criteria (Y/N)	Screening Criteria		
		Criterion A: Provides 45,000 recreation user-days?	Criterion B: Comply with Existing Codes and Regulations	Criterion C: Available for Public Use?
No Action Alternative	N	N	Y	N
RA1. Create Stream Access	N	N (14,610)	Y	Y
RA2. Expand and Improve Existing Private Lake Access	N	Y (120,350)	Y	N
RA3. Develop a Series of Ponds	N	N (15,936)	Y	Y
MA1. Little Otter Creek Reservoir – Proposed Action	Y	Y (57,104)	Y	Y
DPA1. Alternative Reservoir Location – Site 2	N	N (36,188)	Y	Y
DPA2. Alternative Reservoir Location – Site 3	N	N (38,678)	Y	Y
DPA3. Alternative Reservoir Location – Site 4	Y	Y (81,838)	Y	Y
DPA4. Alternative Reservoir Location – Site 5	Y	Y (70,882)	Y	Y
RA4. Combination of Create Stream Access and Alternative Reservoir Locations – Site 3	Y	Y (53,288)	Y	Y

2.4 Multipurpose Alternatives Analysis

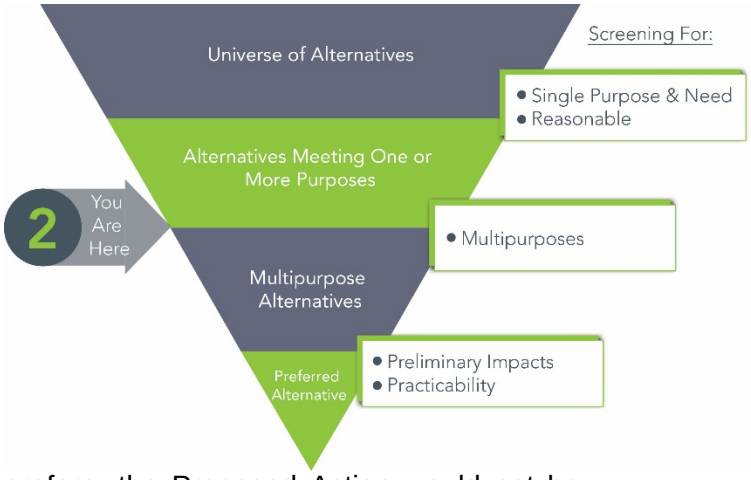
It is important to determine the preferred multipurpose alternative that meets all three project purposes and that has the least environmental impact.

The preferred alternative determination will be conducted from an evaluation of the following:

- The multipurpose alternatives that meet the screening criteria for each of the three project purposes. It will also include an analysis of impacts to aquatic resources and whether the alternative is practicable. Practicability indicates whether the alternative is "available and capable of being done," and it includes a consideration of cost, logistics, and technology in light of the project purposes.
- As indicated in Figure 1.4-1, which shows the steps in the process for screening alternatives and determining the multipurpose preferred alternative, all possible multipurpose alternatives will be generated from individual alternatives that meet the screening criteria for one or more of the project purposes. In this document, to follow the steps of the determination process, Section 2.4.1 will combine individual alternatives (if necessary), Section 2.4.2 will evaluate the multipurpose alternatives, and Section 2.4.3 will determine the multipurpose preferred alternative.

2.4.1 Multipurpose Combination of Alternatives

Creating Alternative Combinations. Alternatives were screened to determine whether they met criteria for any of the three project purposes of water supply, water-based recreation, and flood damage reduction. The following describes how alternatives were carried forward for combination with other alternatives.



- **Multipurpose Alternatives (MA) meeting criteria for all three purposes.** These alternatives would not be combined with other alternatives. The Proposed Action was the only alternative that met the screening criteria for all three purposes; therefore, the Proposed Action would not be combined with any other alternative.

This section evaluates alternatives that meet all three project purposes.

- **Dual Purpose Alternatives (DPA) meeting criteria for two project purposes.** Alternatives that met the screening criteria for two of the project purposes would be combined only with an alternative that provided the third purpose, and it would not be combined with an alternative for the purposes it already met.
- **Alternatives meeting criteria for one project purpose (Water Supply [WA], Water-Based Recreation [RA], or Flood Damage Reduction [FA] Alternatives).** Alternatives that met one of the project purposes and had the fewest environmental impacts for

wetlands, streams, or forest, or that had the lowest cost, were carried forward to be combined with other alternatives in this section.

- **No Action Alternative.** Although this alternative does not meet any of the project purposes, it is carried forward as a baseline comparison, as is required by NEPA.

Table 2.4.1-1 details the environmental impacts and costs of the No Action alternative, the Proposed Action, and other alternatives meeting the screening criteria for each purpose.

Analyzing the Preferred Alternative. Upon creation of multipurpose alternative(s) using combination of alternatives with the fewest environmental impacts or lowest cost, all multipurpose alternatives (those meeting all three project purposes and needs) are carried forward for the preferred alternative analysis. Note that the preferred alternative analysis considers impacts to threatened or endangered species and also follows the 404(b)(1) guidelines, which focus on aquatic resources. Environmental impacts that were evaluated include wetlands, streams, and forests. Aquatic impacts were evaluated consistent with the CWA and included jurisdictional streams and wetlands. Forest impacts were evaluated as a proxy for impacts to the ESA-listed Indiana bats (*Myotis sodalis*) and northern long-eared bats (*Myotis septentrionalis*). Other environmental resources and impacts are evaluated in detail in Sections 3 and 4 of this SEIS.

As shown in Table 2.4.1-1, the following alternatives meet one or more of the project purposes:

Alternatives meeting all three project purposes. The Proposed Action – Little Otter Creek Reservoir (MA1) – is the only alternative that meets all three of the project purposes.

Alternatives meeting two project purposes. The following three alternatives meet the screening criteria for water supply and water-based recreation project purposes:

- Alternative Reservoir Location – Site 4 (DPA3)
- Alternative Reservoir Location – Site 5 (DPA4)
- Combination of Alternative Reservoir Locations – Sites 2 and 3 (DPA5)

Alternatives meeting one project purpose. Three alternatives meet only the screening criteria for water supply, three alternatives meet only the screening criteria for flood damage reduction, and one alternative meets only the screening criteria for water-based recreation.

Alternatives that meet only the screening criteria for water supply include:

- City of Plattsburg Water Supply (WA5)
- Missouri River (WA6)
- Combination of Shoal Creek, Hamilton Lake Modification, and Breckenridge Lake Modification (WA13)

Alternatives that meet only the flood damage reduction screening criteria include:

- Floodplain Acquisition (FA2)
- Dry Dam Detention 100-year Storage (FA9)
- Combination of Small Detention Structures and Dry Dam Detention 50-Year Storage (FA12)

Alternative that meets only the water-based recreation screening criteria include:

- Combination of Create Stream Access and Alternative Reservoir Location Site 3 (RA4)

Alternatives that meet one or two of the project purposes of water supply, water-based recreation, or flood damage reduction can be combined with other alternatives to meet the multipurpose criteria. If a clear-cut alternative cost less and had fewer impacts than others providing the same purposes (e.g., FA2 for flood damage reduction, and RA4 for water-based recreation), that alternative was the only one used for combinations. However, there was no clear-cut single alternative for water supply, and so two water supply alternatives were used for combinations.

Table 2.4.1-1. Comparison of Individual Alternatives Meeting the Screening Criteria.

Alternative	Meets Project Purpose of			Installation Costs[1] ($)	Permanent Environmental Impacts		
	Water Supply	Flood Damage Reduction	Recreation		Stream[2] (feet)	Wetland[3] (acres)	Forest[4] (acres)
No Action				0	0	0	0
Proposed Action – Little Otter Creek (MA1)	X	X	X	17,120,000	25,540	6.6	97.6
Alternative Reservoir Location – Site 4 (DPA3)	X		X	25,250,000	38,630	8.8	123.4
Alternative Reservoir Location – Site 5 (DPA4)	X		X	24,140,000	33,580	10.9	157.8
Combination of Alternative Reservoir Location – Sites 2 and 3 (DPA5)	X		X	47,940,000	40,640	8.8	299
City of Plattsburg Water Supply (WA5)	X			73,660,000	0	2.9	29.8
Missouri River (WA6)	X			94,030,000	0	1.9	29.3
Combination of Shoal Creek, Hamilton and Breckenridge Lake Modification, (WA13)	X			34,030,000	19,550	34.6	18.2
Floodplain Acquisition (FA2)		X		922,900	0	0	0
Dry Dam Detention 100-year Storage (FA9)		X		14,000,000	450	0.4	3.6
Combination of Small Detention Structures and Dry Dam Detention 50-Year Storage (FA11)		X		12,810,000	1,780	0.4	3
Combination of Create Stream Access and Alt Reservoir Site 3 (RA4)			X	20,290,000	23,600	3.9	196.1

Note: Green rows indicate alternatives carried forward for more analysis, and red rows indicate alternatives that were eliminated from consideration as a combined multipurpose alternative.

[1]Installation costs are detailed in Appendix B.

[2] Source: NHD. [3] Source: NWI. [4]Source: NLCD

Combining Alternatives to Create Multipurpose Alternatives. The following three water supply alternatives would need to be combined with an alternative or alternatives that provide water-based recreation and flood damage reduction to meet all three project purposes:

- City of Plattsburg (WA5)
- Missouri River (WA6)
- Combination of Shoal Creek, Hamilton Lake Modification, and Breckenridge Lake Modification (WA13)

Among these, the combination of Shoal Creek, Hamilton Lake Modification, and Breckenridge Lake modifications alternative (WA13) results in the greatest environmental impacts and was eliminated. The City of Plattsburg alternative (WA5) has similar environmental impacts as the Missouri River alternative (WA6), but it has a cost that is over $20 million lower. Therefore, the City of Plattsburg alternative (FA2) was chosen to be the only water supply alternative to be considered with other single or dual-purpose alternatives to meet the multipurpose alternatives for the preferred alternative evaluation.

The following three alternatives provide water supply and recreation, and thus would need to be combined only with a flood damage reduction alternative to meet all three project purposes:

- Alternative Reservoir Location – Site 4 (DPA3)
- Alternative Reservoir Location – Site 5 (DPA4)
- Combination of Alternative Reservoir Locations – Sites 2 and 3 (DP5)

The following three flood damage reduction alternatives met the screening criteria for the single purpose of flood damage reduction, and they could be combined with the two water supply and recreation alternatives, or with an alternative for water-based recreation and an alternative for water supply:

- Floodplain Acquisition (FA2)
- Dry Dam Detention 100-year Storage (FA9)
- Combination of Small Detention Structures and Dry Dam Detention 50-Year Storage (FA11)

Among these, the floodplain acquisition alternative (FA2) results in fewer environmental impacts and a lower cost than the dry dam detention 100-year storage alternative (FA9) and the combination of small detention structures and dry dam detention 50-year storage alternative (FA11). Therefore, the floodplain acquisition alternative (FA2) was chosen to be the only flood damage reduction alternative to be considered with other single or dual-purpose alternatives to meet the multipurpose alternatives for the preferred alternative evaluation.

One alternative met the screening criteria for the single purpose of water-based recreation, and it could be combined with an alternative for flood damage reduction and an alternative for water supply.

- Combination of Create Stream Access and Alternative Reservoir Location Site 3 (RA4)

Alternative FA2 can be combined with the alternative reservoir location – site 4 (DPA3) and alternative reservoir location – site 5 (DPA4) alternatives to create multipurpose alternatives for the preferred alternative evaluation. Alternatives FA2 and RA4 can be combined with City of

Plattsburg Water Supply (WA5) to create a multipurpose alternative for the preferred alternative evaluation.

Alternatives Eliminated from Consideration as the multipurpose Preferred Alternative. The following alternatives are eliminated from consideration since they cannot be combined with another alternative to meet the three purposes and needs, or because they have more environmental impacts and costs than another alternative:

- The Missouri River (WA6)
- Combination of Alternative Reservoir Locations – Sites 2 and 3 (DPA5)
- Combination of Shoal Creek, Hamilton Lake Modification, and Breckenridge Lake Modification (WA13)
- Dry Dam Detention 100-Year Storage (FA9)
- Combination of Small Detention Structures and Dry Dam Detention 50-Year Storage (FA11)

Alternatives Carried Forward for Consideration for the Preferred Alternative. The multipurpose alternative evaluations include an evaluation of the following multipurpose alternatives:

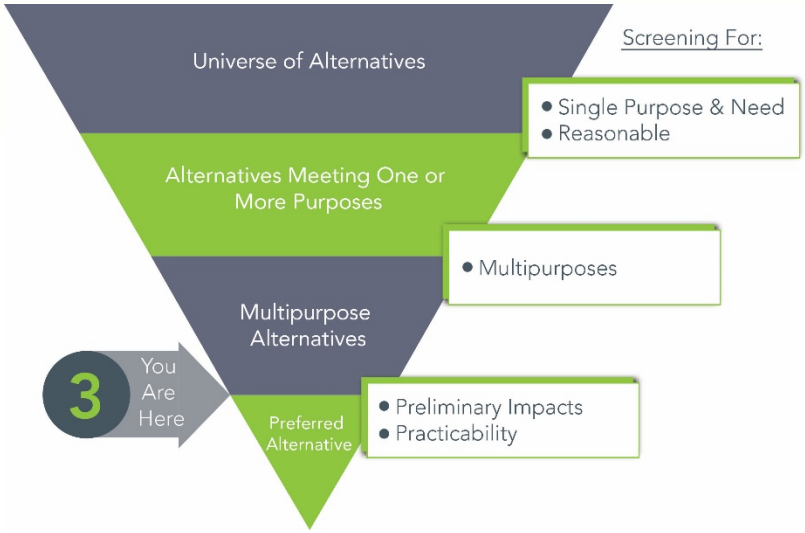
- No Action Alternative
- Proposed Action – Little Otter Creek Reservoir (MA1)
- Alternative Reservoir Location – Site 4 and Floodplain Acquisition (MA2)
- Alternative Reservoir Location – Site 5 and Floodplain Acquisition (MA3)
- City of Plattsburg Water Supply and Floodplain Acquisition and Alternative Reservoir Location – Site 3 and Create Stream Access (MA4)

2.4.2 Preferred Alternative Evaluation

This section analyzes the environmental impacts and cost of the multipurpose alternatives to identify the Preferred Alternative for the project. The Preferred Alternative analysis follows the 404(b)(1) guidelines, which focus primarily on aquatic resources.

The multipurpose Preferred Alternative analysis is based on the evaluation of the four alternatives described in the above section.

Table 2.4.2-1 provides a comparison of environmental impacts and costs for the multipurpose alternatives.



This section determines the Preferred Alternative.

Table 2.4.2-1. Multipurpose Alternatives Comparison.

Multipurpose Alternatives	Installation Costs[1] ($)	Permanent Environmental Impacts		
		Stream[2] (feet)	Wetland[3] (acres)	Forest[4] (acres)
No Action	0	0	0	0
Proposed Action – Little Otter Creek Reservoir (MA1)	**17,120,000**	**25,540**	**6.6**	**97.6**
Alternative Reservoir Location – Site 4 and Floodplain Acquisition (MA2)	26,170,000	38,630	8.8	123.4
Alternative Reservoir Location – Site 5 and Floodplain Acquisition (MA3)	25,060,000	33,580	10.9	157.8
City of Plattsburg Water Supply and Floodplain Acquisition and Alternative Reservoir Location – Site 3 and Create Stream Access (MA4)	94,870,000	23,600	6.8	225.9

Note: Preferred alternative is highlighted in green.
[1] Project Installation or Capital Costs shown and are detailed in Appendix B.
[2] Source: NHD
[3] Source: NWI
[4] Source: NLCD

The four multipurpose alternatives (MA1, MA2, MA3, and MA4) are compared for impacts to aquatic resources and threatened and endangered species habitat, as well as practicability, in the following sections.

Threatened and Endangered Species Habitat Evaluation. Federally listed species for Caldwell County include the Topeka shiner and the northern long-eared bat and Indiana bat. The Proposed Action study area was surveyed for federally endangered species; no endangered species were identified as using the project area. Other areas in and outside Caldwell County have not been surveyed for federally threatened and endangered species.

The Proposed Action would result in an estimated 13,090 fewer feet of stream impacts than alternative MA2 and an estimated 8,040 fewer feet of stream impacts than alternative MA3. The Proposed Action would result in an estimated 1,940 more feet of stream impacts than alternative MA4.

Additionally, the Proposed Action would result in an estimated 25.8 fewer acres of upland forest impacts than alternative MA2 and an estimated 60.2 fewer acres of upland forest impacts than alternative MA3. The Proposed Action would result in an estimated 128.3 fewer acres of upland forest impacts than alternative MA4

Wetland Evaluation. The Proposed Action would result in an estimated 2.2 fewer acres of wetland impacts than alternative MA2 and an estimated 4.3 fewer acres of wetland impacts than alternative MA3. The Proposed Action would result in an estimated 0.2 acre fewer wetland impacts than alternative MA4.

Comparing the impacts to aquatic resources and threatened and endangered species habitat indicates that alternatives MA2 and MA3 both have higher impacts on streams, wetlands, and upland forests than the Proposed Alternative and alternative MA4. Alternatives MA2 and MA3 are eliminated from further consideration.

Practicability Evaluation. An alternative is practicable if it is "available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes." The Proposed Action and alternative MA4 are available based on existing technology, and the logistics of implementing either of these actions is within the construction capabilities of contractors in the region.

However, when considering cost, the sponsor is a rural county with little manufacturing and ongoing operational, capital, and maintenance responsibilities. With a poverty rate of 12.7%, incremental taxes have a more significant impact on low income residents in Caldwell County than in many other areas. Recognizing their acute need for a dependable water supply, County residents authorized a 0.5% sales tax increase in 2002 to provide local funding for the project. The sponsor has received obligated funds from NRCS and the State of Missouri for the project. Each entity is willing and able to provide cost share for the project consistent with the funding level required for the Proposed Action.

The incremental funding required for alternative MA4, $77.8 million, would be borne entirely by the sponsor. This funding requirement would be 10 times the County's annual budget, and the sponsor does not have bonding capacity nor accrued money in other areas to pay for the project in addition to maintaining the ongoing operations critical to the safety, health and welfare of the residents and visitors in Caldwell County. The 0.5% sales tax receipts have ranged from $189,000 to $286,000 each calendar year since 2003, when tax collections began. If the receipts from the maximum revenue year, $286,000, were applied to the $77.8 million principal on a loan to construct the project with a zero percent interest rate, the term of the loan would be 272 years. A

loan with an interest rate above 0% would never be paid down. These loan terms are not available to the sponsor, and thus a loan of $77.8 million cannot be considered by the sponsor. An alternative requiring an additional $77.8 million from the sponsor is beyond the capability of the sponsor to provide adequate funding, and thus makes implementation of alternative M4 not practicable.

The Proposed Action is the lowest cost alternative by more than $10 million; less expensive than alternative MA2, alternative MA3, and alternative MA4. The Proposed Action was determined to be the National Economic Development alternative (USWRC, 1983) in the FEIS and also as evaluated in this document. In the FEIS, the proposed action is called “LO-1.”

Summary of Preferred Alternative Analysis. The Preferred Alternative has the lowest permanent impact on aquatic resources and potential threatened and endangered species habitat among practicable alternatives and is the Proposed Action.

1.0 Introduction and Purpose and Need

2.0 Alternatives Analysis

3.0 Affected Environment and Predicted Environmental Consequences

4.0 Cumulative and Growth-Inducing Effects

5.0 Comparison of Alternatives and Mitigation

6.0 Compliance and Consultation with Applicable Laws, Policies, and Plans

7.0 Public Involvement

8.0 List of Preparers

9.0 Distribution List

10.0 Reference

The alternatives analysis and Preferred Alternative determination evaluated the potential alternatives that met the purpose and need. The Proposed Action will be further evaluated through the following sections. The No Action alternative will also be evaluated for comparison, but the remaining alternatives will not be evaluated because they were not determined to be the Preferred Alternative. The following sections are intended to update the 2003 FEIS.

3.1 Resources Not Evaluated in Detail

Protected Lands

This issue was eliminated from further study because no properties in the project area are classified as a state or federal park, wildlife refuge or are funded with Land and Water Conservation funds.

Air Quality

The Clean Air Act (CAA) was enacted in 1970 to control air pollution on a national level. The CAA identified six common air pollutants of concern (criteria pollutants): carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (PM_x), and sulfur dioxide (SO_2). National air quality standards define allowable concentrations of criteria pollutants in ambient air (EPA 2018a).

Exposure to these substances can harm the environmental, result in public health concerns, and cause property damage. Health impacts include respiratory damage, heart or lung disease, or premature death. Environmental effects include smog, acid rain, radiation, and ozone depletion (EPA 2018b).

Implementation and operation of the Proposed Action would result in emissions associated with personnel transport vehicles, visitor vehicles, and recreational activities. Visitor vehicle traffic and recreational activities would be seasonal and vary day to day. Operational emissions would result in incremental increase in criteria pollutants; however, Caldwell County is currently in attainment for all criteria pollutants (EPA 2018c). The Proposed Action would result in marginal impact to air quality; therefore, this issue was eliminated from further study.

Construction of the Proposed Action would result in temporary emissions of criteria air pollutants and fugitive dust as a result of soil disturbance and the use of on-site construction equipment. Additionally, emissions of criteria pollutants would result from off-site trucks hauling water and construction materials to the Project site. Construction emissions can vary substantially from day to day, depending on the level of activity and the specific type of operation and with regards to dust, the prevailing weather conditions (e.g., wind conditions). Fugitive dust ($PM_{2.5}$) emissions would primarily result from site preparation and road construction activities. NOx and CO emissions would primarily result from the use of construction equipment and motor vehicles. Construction is anticipated to commence in June 2019 and would require approximately 15 months to complete.

Prior to commencement of construction activities, a construction permit must be obtained from the Missouri Department of Natural Resources, Air Pollution Control Program. Construction activities would be subject to several control measures per the requirements of the Missouri Air Conservation Commission (MDNR 2017b). Refer to Section 5.5 for mitigation measures.

Rangeland Resources

This issue was eliminated from further study because no rangelands are in the project area.

3.2 Resources Evaluated in the 2003 FEIS That Have Not Changed

Land Use

Caldwell County purchased the land intended for use for the Proposed Action since the preparation of the FEIS and approval of the ROD in May 2003. The current land use is idle or leased for land use consistent with the previous owner's use of the land. Conservation practices outlined in the FEIS for watershed protection in the tributary watershed will be accomplished as indicated. There has been no substantial change in the affected environment and impact analysis to land use within the project area since preparation of the FEIS and approval of the ROD in May 2003. No further analysis was completed.

Groundwater

This issue was eliminated from further study because there have been no substantial changes in affected environment and impact analysis to groundwater since the FEIS and approval of the ROD in May 2003.

Invertebrates

This issue was eliminated from further study because there have been no substantial changes in affected environment and impact analysis to invertebrates within the project area since preparation of the FEIS and approval of the ROD in May 2003.

Geology

This issue was eliminated from further study because there have been no substantial changes in geology since the FEIS and approval of the ROD in May 2003.

3.3 Climate

3.3.1 Affected Environment

The Little Otter Creek watershed is entirely located in Caldwell County, just southeast of Hamilton, Missouri, and approximately 38 miles northeast of Kansas City, Missouri. Land use within the county is primarily agricultural. Table 3.3.1-1 shows weather data from 2010–2015. Data was retrieved from the Hamilton 2 W, Missouri U.S. COOP: 233568 Weather Station.

Table 3.3.1-1. 2010-2015 Caldwell County Climate Patterns.

Year	Mean Max (degrees Fahrenheit)	Mean Min (degrees Fahrenheit)	High (degrees Fahrenheit)	Month	Low (degrees Fahrenheit)	Month	Total Precipitation (inches)
2015	57.4	34.3	94	June	-10	February	23.75
2014	60.6	38.3	95	July	-19	February	37.89
2013	61.2	38.6	101	August	-16	December	36.57
2012	67.8	41.2	105	July	2	January	29.24
2011	65.2	41.8	99	August	-21	February	39.43
2010	61.8	39.5	98	August	-18	January	46.18

Source: NOAA 2015

As illustrated in Table 3.3.1-1, during this six-year time period, the annual high varied by 10 degrees, and the annual low temperature varied by 23 degrees. Precipitation varied from a low of 23.75 inches to 46.18 inches, which results in a difference of 22.43 inches or a 94 percent increase over the five-year low. As discussed in the project purpose section, global climate change is likely to result in even greater variability in temperature and precipitation patterns in the future.

3.3.2 Direct and Indirect Effects of the No Action Alternative

The No Action alternative would have no impacts on the overall climate of Caldwell County.

3.3.3 Direct and Indirect Effects of the Proposed Action

The Proposed Action is not anticipated to have significant impacts on the climate of Caldwell County. The Proposed Action is a sustainable action that meets the need for mitigating future impacts from climate change for Caldwell County.

3.4 Land Use

3.4.1 Residential

3.4.1.1 Affected Environment

The Proposed Action is in a rural part of Caldwell County, in an area largely comprised of agricultural land. The City of Hamilton is located an approximately three miles northwest of the project site, and U.S. Highway 36 is directly north of the Proposed Action. According to the U.S. Census Bureau's 2010 census, the population of Caldwell County was 9,424 and the watershed

population was 237 people (using census block data and the nearest spatial approximation of the watershed boundaries).

The U.S. Office of Management and Budget added Caldwell County to the Kansas City MSA in 2003, indicating that Caldwell County has a strong commuting tie with the Kansas City metropolitan area. The strong commuting tie is defined as at least 25 percent of workers in the county commuting toward the Kansas City metropolitan area, or 25 percent of the workers in the county residing in the Kansas City metropolitan area (Federal Register 2010). Identifying Caldwell County as part of the Kansas City MSA indicates that the population in Caldwell County may change from a rural profile to a more suburban one in future years as the Kansas City metropolitan area continues to expand. In addition, the implementation of a reliable water supply in Caldwell County may increase both the gross population growth and per capita water usage as more industry and development are attracted to the area (MDNR 2007). According to the Mid-America Regional Council's statistical data, counties added to the Kansas City MSA have had an average of 1.2 percent annualized population growth since the individual county's inclusion in the MSA (MARC 2016).

3.4.1.2 Direct and Indirect Effects of the No Action Alternative

Residential growth within the project area is expected to continue, incrementally, under the No Action alternative, which would continue to strain the projected water supply for the area. Additionally, the No Action alternative would not add recreational opportunities to meet the unmet demand within the region, and it would not provide flood damage reduction.

3.4.1.3 Direct and Indirect Effects of the Proposed Action

Construction of the Proposed Action would not displace any current residences. However, sections of uninhabited farmland would be purchased in accordance with the Uniform Relocation Act. Project construction activities could lead to temporary short-term impacts to residents such as construction noise and traffic, and they could result in limited access to adjoining properties.

Traffic would use the existing state and U.S. highways and, therefore, would be largely unaffected during construction. Short-term, temporary impacts could occur because of lane closures necessary to accommodate specific construction activities or phases. These activities could include delivery of materials, equipment mobilization, and construction of tie-ins and cross-overs.

Field and residential driveways could be temporarily affected during construction, resulting in the need for regrading or realigning drive approaches. Limited access to properties could occur during this time.

Noise associated with construction would be temporary. No long-term noise impacts are anticipated. Noise associated with heavy equipment is common in the agricultural region during planting and harvest periods. An increase in recreational opportunity within the area may result in an increase of visitors; however, traffic and associated noise increases would be incremental and seasonal.

3.4.2 Commercial/Industrial/Infrastructure/Utilities/Other Lands

3.4.2.1 Affected Environment

There are no commercial or industrial facilities, infrastructure, utility buildings, or substations within the project area. Caldwell PWSD #3 owns a water transmission pipeline near the northern end of the reservoir, and up to 3,000 linear feet of pipeline would need to be relocated as a result of the Proposed Action.

3.4.2.2 Direct and Indirect Effects of the No Action Alternative

Changes to the existing utilities within the project area, such as relocation, would not occur under the No Action alternative.

3.4.2.3 Direct and Indirect Effects of the Proposed Action

All utility companies servicing the area would be notified of the Proposed Action. Relocation of the Caldwell PWSD #3 waterline would be completed in coordination with PWSD #3.

Transmission pipelines would be constructed as needed to connect customers to the new water supply. A conceptual diagram of the transmission lines has been created, but it would be customized at the time of construction, based on customer needs. The conceptual diagram is found in Figure 2.1-1. The transmission lines are anticipated to affect wetlands, streams, and forest during construction. Environmental considerations and permits would be completed prior to construction.

A water treatment plant would be constructed as needed to treat raw water from the new water source. Construction of the water treatment plant and transmission lines is not part of this project, but it is a connected action. The water treatment plant is anticipated to be constructed in uplands and to have a limited impact on wetlands, streams, and forest. The water treatment plant could potentially affect farmland or pastureland.

The Proposed Action would inundate 1.1 miles of Ridgeway Drive and NE Ponderosa Road. NE Ponderosa Road will be abandoned. Adequate and nearby alternative routes are readily available within 1 mile of the closures for residents or other roadway users in the area.

3.4.3 Forest/Woodland Resources

3.4.3.1 Affected Environment

No substantial change has occurred in the affected environment and impact analysis to forest resources within the project area since preparation of the FEIS and approval of the ROD in May 2003. Forestland within the Little Otter Creek watershed comprises an estimated 493 acres. Forestland within the Proposed Action project footprint comprises an estimated 98 acres, or 20 percent of the Little Otter Creek watershed. Forest types are predominantly central hardwoods with the only native conifer being eastern red cedar (*Juniperus virginiana*). Many of the timbered areas occur along Little Otter Creek and its tributaries. The forest stands are second growth timber and generally in poor condition (NRCS 2003). Many of the woodlots are grazed (NRCS 2003).

A partial list of species within the riparian corridor identified during on-site resource surveys (MSU 2015b) included the following species: American elm (*Ulmus americana*), American sycamore

(*Platanus occidentalis*), black locust (*Robinia pseudoacacia*), black willow (*Salix nigra*), common hackberry (*Celtis occidentalis*), eastern cottonwood (*Populus deltoides*), eastern red cedar, green ash (*Fraxinus pennsylvanica*), honey locust (*Gleditsia triacanthos*), Ohio buckeye (*Aesculus glabra*), Osage orange (*Maclura pomifera*), red mulberry (*Morus rubra*), red oak (*Quercus rubra*), and silver maple (*Acer saccharinum*). Figure 3.4.3-1 shows a portion of the forested area within the Proposed Action boundary.

Figure 3.4.3-1. Forested Area within Little Otter Creek Project Area (*photo taken August 17, 2017*)***.***

3.4.3.2 Direct and Indirect Effects of the No Action Alternative

The No Action alternative would have no impacts on woodland or forest resources.

3.4.3.3 Direct and Indirect Effects of the Proposed Action

Based on the analysis of aerial photographs and the NLCD, the Proposed Action would affect an estimated 98 acres of upland forest. An estimated additional 27.8 acres of upland forest would be affected by the treated water distribution system. The treated water distribution system will be built in phases as resources become available. The exact timeline for construction is not known. The treated water distribution system has not been designed. A conceptual configuration of the

distribution system is provided as an example in Figure 2.1-1. The actual location for the distribution system pipelines will be adjusted during the design to avoid or minimize impacts.

3.5 Water Resources

3.5.1 Streams

3.5.1.1 Affected Environment

Little Otter Creek drains an area of 6,323 acres at its confluence with Otter Creek. At the mouth of Little Otter Creek, it is a fourth-order perennial stream. Stream substrates consist of sand, gravel, cobble, and bedrock (NRCS 2003). The University of Missouri's Center for Applied Research and Environmental Systems (CARES) mapping site (1:24,000 Rivers and Streams layer) lists Little Otter Creek as both a perennial and an intermittent stream (University of Missouri 2015). The CARES mapping site lists Little Otter Creek as intermittent north of the confluence of an unnamed tributary, approximately 1 mile south of U.S. Highway 36, and perennial south of the confluence. Ponds are located upstream of many small tributaries draining to Little Otter Creek. The largest of the ponds is Penney Lake, a 14-acre lake located at the headwaters of an unnamed tributary to Little Otter Creek.

According to the FEIS, vegetation along the banks consists primarily of second-growth trees with an understory of shrubs, weeds, and grass (NRCS 2003). A riparian buffer helps to stabilize the creek's streambanks; however, half of the Little Otter Creek stream reach, which is within the Proposed Action boundary starting north of the proposed dam site, exhibits moderate to severe streambank erosion. Streambank erosion within this reach produces 65 percent of the total streambank erosion within the 6,323-acre watershed (NRCS 2003). Figure 3.5.1.1-1 shows photos of areas of streambank erosion on Little Otter Creek.

Figure 3.5.1.1-1. Little Otter Creek Streambank Erosion (*photos taken in January 2014 on reaches downstream [left] and upstream [right] of Northeast Ridgeway Road*)**.**

3.5.1.2 Direct and Indirect Effects of the No Action Alternative

The No Action alternative would not result in direct impacts to the stream network within the project area. Under the No Action alternative, the Proposed Action would not be constructed. Streambank erosion would likely continue along the stream. Water quality impacts associated with streambank erosion would likely continue.

3.5.1.3 Direct and Indirect Effects of the Proposed Action

The USACE and USEPA completed an AJD (USACE 2010) to determine the extent of waters of the U.S. on the site of the Proposed Action. The AJD included an evaluation of streams within the project dam and normal pool footprint. Implementation of the Proposed Action would result in an estimated 36,243 feet of stream impacts because of inundation and dam construction. According to the AJD, the types of stream that would be affected include an estimated 20,220 linear feet of perennial stream, 14,569 linear feet of intermittent stream, and 1,454 linear feet of ephemeral stream.

Figure 3.5.1.3-1 shows the location and types of streams that would be affected by both the dam embankment and within the area inundated by the normal pool. The stream resources would be converted from a riverine system to a lacustrine system where inundation occurs. Please note that although the preliminary screening of alternatives used existing databases such as NHD to compare the impacts of different alternatives on an apples-to-apples basis, additional information has been obtained by field surveys of the Little Otter Creek site, and an AJD for the extent of waters of the U.S. was issued by USACE and USEPA. The AJD, which determined areas that are waters of the U.S., and thus that are under the jurisdiction of the CWA, was first issued on March 9, 2010 (USACE 2010), and was reissued on March 16, 2015.

The Proposed Action may cause a change in water temperatures in the stream below the reservoir. An increase or decrease in downstream water temperature may affect aquatic habitat. It is unknown how far downstream water temperatures might be affected. Low dissolved oxygen is not expected to occur, because surface water is anticipated to discharge from the structure. However, if there is a discharge drawn from deeper in the lake during periods of thermal stratification, low dissolved oxygen could be a concern as well.

An Ecological Flows Task Force working group – led by NRCS and including staff from MDNR and MDC – in conjunction with the project sponsor, has been formed to address ecological flow releases. The group is developing a water management plan to minimize downstream aquatic impacts. During dry periods, these releases will ensure water is passed through the system, even when the reservoir level is below the principal spillway elevation. The task force has also completed field visits to similar lakes and found that they exhibit a constant seepage release of 1 to 3 gpm downstream of the dam.

Developing recreation facilities and building the water treatment plant are not anticipated to create additional permanent stream impacts. Water transmission lines may result in temporary impacts. After avoidance and minimization, mitigation of unavoidable impacts to aquatic resources will be completed in accordance with an approved mitigation plan.

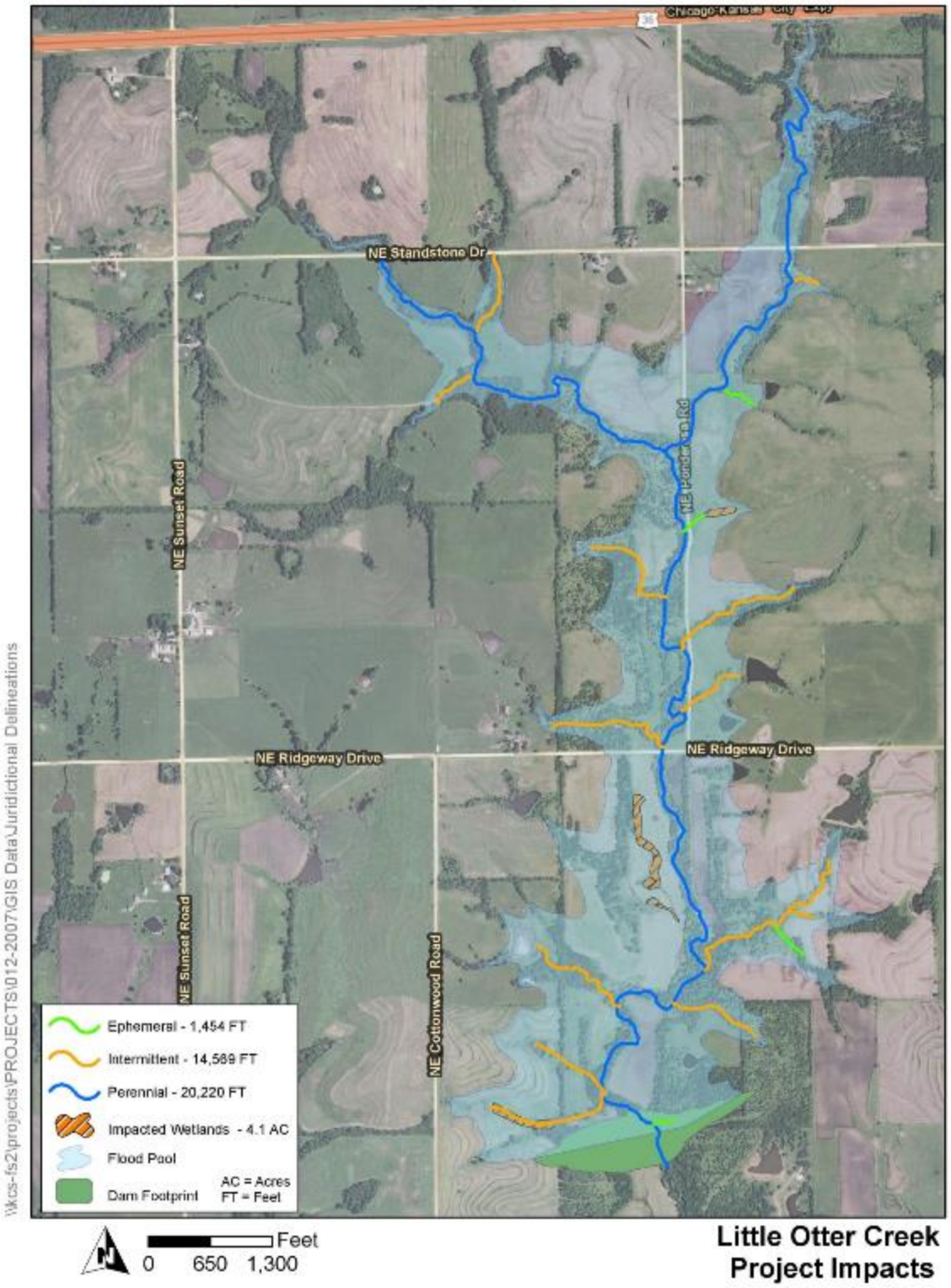


Figure 3.5.1.3-1. Approved Jurisdictional Determination Streams and Wetlands within the Project Footprint.

3.5.2 Wetlands

The USACE and EPA define wetlands as “those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions” (33 CFR 328).

NRCS and USACE completed a wetland determination of the Proposed Action location on November 9, 2009 (USACE 2010). Data for the field research were collected in accordance with the methods set forth in the *1987 U.S. Army Corps of Engineers Wetlands Delineation Manual* (USACE 1987) and what at that time was the most recent version of the regional supplement, the *Interim Regional Supplement to the U.S. Army Corps of Engineers Wetland Delineation Manual: Midwest Region* (USACE 2008).

3.5.2.1 Affected Environment

Wetlands within the watershed have historically been degraded in size and function by human activities, including extirpation of beavers and agricultural activities. Agricultural activities have resulted in drainage of wetlands, as well as increased erosion and downcutting of streams. The USGS topographic map indicated several ephemeral, intermittent, or perennial streams within the study area, but it did not show any wetland areas (USGS 2016). However, USFWS NWI data shows several freshwater emergent, freshwater forested/shrub, and riverine wetlands, as well as several freshwater ponds within the project area (USFWS 2017).

The NRCS and USACE conducted approved jurisdictional determination (AJD) in 2009 to identify waters of the U.S., including jurisdictional wetlands. The AJD was issued in 2010 and was reconfirmed in 2015. Four areas of wetlands were identified – two near the main stem of Little Otter Creek and two along tributaries. The total acreage of these four wetlands is 4.1 acres (Figure 3.5.1.3-1). This value is different from the acreage determined in the alternatives screening process, which used the more coarse NWI mapped wetlands to compare all alternatives on an apples-to-apples basis.

The jurisdictional determination shows that two wetlands located along small tributaries were dominated with emergent (herbaceous) vegetation: prairie cordgrass (*Spartina pectinata*) in one wetland, and a monoculture of reed canarygrass (*Phalaris arundinacea*) in the other. These two wetlands were respectively 1.2 acres and 0.5 acre. In addition, several small patches of wetlands near the main channel of Little Otter Creek consisted of a mix of emergent and scrub-shrub (small woody) vegetation. These wetlands totaled 2.4 acres. Figure 3.5.2.1-1 shows a photograph of one of the emergent and scrub-shrub wetlands.

Figure 3.5.2.1-1. Typical Emergent Wetland Found at Little Otter Creek Site, with Some Scrub-shrub Woody Species.

3.5.2.2 Direct and Indirect Effects of No Action Alternative

The No Action alternative would not result in direct impacts to wetlands since no wetland areas would be permanently inundated. However, wetland habitat quality would continue to be indirectly affected by ongoing agricultural activities within the area.

3.5.2.3 Direct and Indirect Effects of the Proposed Action

Although the preliminary screening of alternatives used existing databases such as the NWI to compare the impacts of different alternatives on an apples-to-apples basis, additional information has been obtained by field surveys of the Little Otter Creek site, and an AJD for the extent of waters of the U.S. was issued by USACE and USEPA. The AJD, which determined areas that are considered to be waters of the U.S., and thus that are under the jurisdiction of the CWA, was first issued on March 9, 2010 (USACE 2010), and was reissued on March 16, 2015.

According to the AJD, 4.1 acres of wetlands would be affected by the project, including 2.4 acres of a mix of emergent and scrub-shrub wetlands, and an additional 1.7 acres of emergent wetland. Figure 3.5.1.3-1 shows the location of the wetlands affected within the project footprint.

As determined in the 2003 FEIS, no net loss of wetlands will result from project activities. After avoidance and minimization, unavoidable impacts to wetlands will be mitigated in compliance with an approved wetlands mitigation plan. Refer to Section 5.5 for further discussion on mitigation measures. If permittee responsible wetland mitigation is utilized, wetland mitigation sites will be selected through collaboration with existing Grand River Basin conservation stakeholders and planners to determine locations that are high priority for Grand River Basin stakeholders, including NGOs, MDNR, MDC and USFWS. However, because the wetland impacts are relatively small, it is likely that wetland credits will be purchased through an existing in-lieu fee program or

mitigation bank unless a permittee responsible wetland project can be more efficiently done as an extension to a permittee responsible stream mitigation project.

3.5.3 Water Quality

Water quality in Missouri is regulated (10 CSR 20-7) by classifying water bodies according to designated beneficial uses and then assigning specific numeric water quality criteria that must be maintained to protect the assigned beneficial uses (MDNR 2014b). Water bodies that are not classified fall under the general criteria (10 CSR 20-7.031[3]) for all waters of the state. Little Otter Creek is an unclassified stream and is regulated under the general criteria (MDNR 2014b).

Water bodies that fail to meet either general or numeric criteria are required to be listed as impaired water bodies under Section 303(d) of the federal CWA.

3.5.3.1 Affected Environment

Little Otter Creek is not currently on Missouri's list of impaired waters under Section 303(d) of the CWA, as amended (1972), and there are no 303(d) listed waters in Caldwell County (MDNR 2016b). However, sediment, pathogens, nutrients, and toxic contaminants threaten the water quality in the Little Otter Creek watershed. Sediment sources include unstable channel banks, road ditches, cropland, pasture, and forestland. Pathogens and nutrients typically come from human activity, livestock, and wildlife sources. Toxic contaminants such as motor oil, gasoline, and other vehicle fluids are likely from roads such as the transportation corridor along U.S. Highway 36.

3.5.3.2 Direct and Indirect Effects of the No Action Alternative

No streams or water bodies would be affected by the No Action alternative. Current water quality concerns would continue, including sediment, pathogens, nutrients and toxic materials from unstable channel banks, road ditches, and inadequately protected cropland, pasture, and forestland.

3.5.3.3 Direct and Indirect Effects of the Proposed Action

Implementation of the Proposed Action is expected to improve the downstream water quality in Little Otter Creek by trapping and treating sediment and plant nutrients entering the structure from upstream. Conservation efforts associated with state and federal working lands programs can be used to protect water quality by reducing the runoff of sediment and nutrients.

The Proposed Action is expected to perform similar to retention basins that typically have pollutant removal efficiencies of 50 to 80 percent for suspended solids, 30 to 65 percent for nitrogen, 30 to 65 percent for phosphorus, less than 30 percent for pathogens, and 50 to 80 percent for metals (USEPA 1999).

The National Pollutant Discharge Elimination System rules require a stormwater pollution prevention plan (SWPPP) on construction sites disturbing 1 acre or more. A SWPPP and an erosion control plan would be prepared for the site. Implementing those plans would minimize impacts to water quality from sediment discharge associated with construction activities.

The Proposed Action will be subject to water quality regulations promulgated by MDNR Drinking Water Section, including the requirement for a Source Water Protection Plan. Compliance with

these regulations, in addition to the ongoing and future conservation programs carried out by NRCS, will assure appropriate water quality protection for the reservoir.

3.6 Aquatic Resources

3.6.1 Fisheries

The NRCS State Conservationist must notify the U.S. Fish and Wildlife Service (USFWS) to solicit recommendations for fish and wildlife resources, in accordance with the provisions of Public Law 83-566 Section 12 (16 U.S.C. Section 1008). The Proposed Action was evaluated for potential impacts to fish and wildlife.

3.6.1.1 Affected Environment

Little Otter Creek – below the confluence of Little Otter Creek and an unnamed tributary – is a typical fourth-order northern Missouri stream that supports a relatively diverse fish community. To determine which species occur in the stream, MDC personnel collected 12 species of fish from Little Otter Creek in May 2001. These species included:

- *Ameiurus melas* – Black bullhead
- *Campostoma anomalum* – Central stoneroller
- *Cyprinella lutrensis* – Red shiner
- *Etheostoma nigrum* – Johnny darter
- *Lepomis cyanellus* – Green sunfish
- *Lepomis microchirus* – Bluegill
- *Lythrurus fumeus* – Redfin shiner
- *Notemigonus crysoleucas* – Golden shiner
- *Notropis dorsalis* – Bigmouth shiner
- *Pimephales notatus* – Bluntnose minnow
- *Pimephales promelas* – Fathead minnow
- *Semotilus atromaculatus* – Creek chub

All of these are common fish species. The bluntnose minnow, fathead minnow, black bullhead, green sunfish, and bluegill are considered very tolerant species that can live in a wide array of aquatic habitats (NRCS 2003).

Little Otter Creek drains to Otter Creek, which in turn drains to Shoal Creek. Prior to 1940, the federally and state-endangered Topeka shiner (*Notropis topeka*) may have occurred in Shoal Creek (MDC 2010). Initial site investigations indicated that Little Otter Creek might have suitable habitat for the Topeka shiner. As a result, MDC conducted a survey in 2001 of the fish community within Little Otter Creek to determine the presence or probable absence of the Topeka shiner. Samples were collected at three locations: (1) at the proposed reservoir site; (2) within the middle reach of the proposed reservoir; and (3) at the upper reach of the proposed pool. No Topeka shiners were collected (NRCS 2003).

After coordination with USFWS to determine survey protocol, a second Topeka shiner survey was completed in October 2015 that covered the following locations in Little Otter Creek:

- All 160 pools within the project study area
- All the areas in the stream considered suitable habitat within the proposed reservoir site
- All the areas in the stream considered suitable habitat 2 miles upstream and downstream of the proposed reservoir

No Topeka shiners were found. All the species found in the 2001 survey, except for the golden shiner, were also found in the 2015 survey, along with several other species. The following list of 17 species were found in the 2015 survey (MSU 2015a):

- *Ameiurus melas* – Black bullhead
- *Ameiurus natalis* – Yellow bullhead
- *Campostoma anomalum* – Central stoneroller
- *Catostomus commersoni* – White sucker
- *Cyprinella lutrensis* – Red shiner
- *Etheostoma nigrum* – Johnny darter
- *Lepomis cyanellus* – Green sunfish
- *Lepomis microchirus* – Bluegill
- *Lythrurus umbratilis* – Redfin shiner
- *Micropterus punctulatus* – Spotted bass
- *Micropterus salmoides* – Largemouth bass
- *Notropis dorsalis* – Bigmouth shiner
- *Notropis stramineus* – Sand shiner
- *Pimephales notatus* – Bluntnose shiner
- *Pimephales promelas* – Fathead minnow
- *Pomoxis nigromaculatus* – Black crappie
- *Semotilus atromaculatus* – Creek chub

3.6.1.2 Direct and Indirect Effects of the No Action Alternative

No threatened or endangered fish species, fisheries of concern, or habitat of concern would be affected by the No Action alternative. Water quality impacts associated with agricultural production and streambank erosion would continue, which could adversely affect aquatic habitat.

3.6.1.3 Direct and Indirect Effects of the Proposed Action

The Proposed Action would inundate an estimated 36,243 feet of stream channel that is home to fish; however, no threatened or endangered fish species or fisheries of concern occur within the project study area. Predatory fish – such as largemouth bass, crappie, and bluegill catfish – would likely escape the reservoir through the spillway and enter the stream. An increase in these fish could result in incremental changes to fish diversity below the reservoir, resulting in adverse changes to diversity. However, predatory species such as bass, crappie, bluegill, and bullhead catfish were found in Little Otter Creek during the 2015 Topeka shiner sampling effort. Given that these predatory species are already in the creek, impacts to downstream or upstream fish populations from escape of species are anticipated to be minimal.

Construction of the Proposed Action would result in potential impacts to fish passage. Fish passage will be obstructed by the construction of the dam. Additionally, the quality, quantity, and

accessibility of fish habitat may be affected or degraded. Changes in discharge regime or water quality could also have indirect impacts on fish species and passage over spillways can result in harm to fish species. The multi-agency Ecological Flows Task Force has developed a water management plan to provide downstream flows that would mimic, to the extent practicable, the natural variability of base and storm flows to minimize downstream impacts. In developing this plan, the Task Force has considered flow magnitude, frequency, duration, timing, and rate of change. The water management plan provides a framework for flow releases from the reservoir. The water treatment plant is not expected to create additional permanent stream impacts, although construction of water transmission lines may result in temporary impacts. After avoidance and minimization, mitigation of unavoidable impacts to aquatic resources will be completed in accordance with the mitigation plan. Refer to Section 5.5 for mitigation.

3.7 Terrestrial Vegetation

There has been no substantial change in the affected environment and impact analysis to terrestrial vegetation within the project area since preparation of the 2003 FEIS and approval of the ROD in May 2003.

The most common land cover types that would be affected by the Proposed Action are cultivated cropland, herbaceous land, and deciduous forest. Typical wildlife for the project area includes whitetail deer, coyotes, raccoons, opossums, striped skunks, squirrels, snakes, turtles, and frogs. Forested areas, trees, and brush thickets may provide nesting habitat for nesting migratory birds.

The USEPA, in conjunction with various state and local agencies, has developed a system to define ecoregions through analysis of the biotic and abiotic similarities and differences in specific regions. North America has been divided into 15 broad Level I ecoregions, which are further divided into Level II ecological regions (USEPA 2012).

Level III ecoregions are smaller ecological areas, and Level IV ecoregions are a subset of the Level III regions. Figure 3.7-1 shows the Level IV ecoregion of the project study area (USEPA 2012).

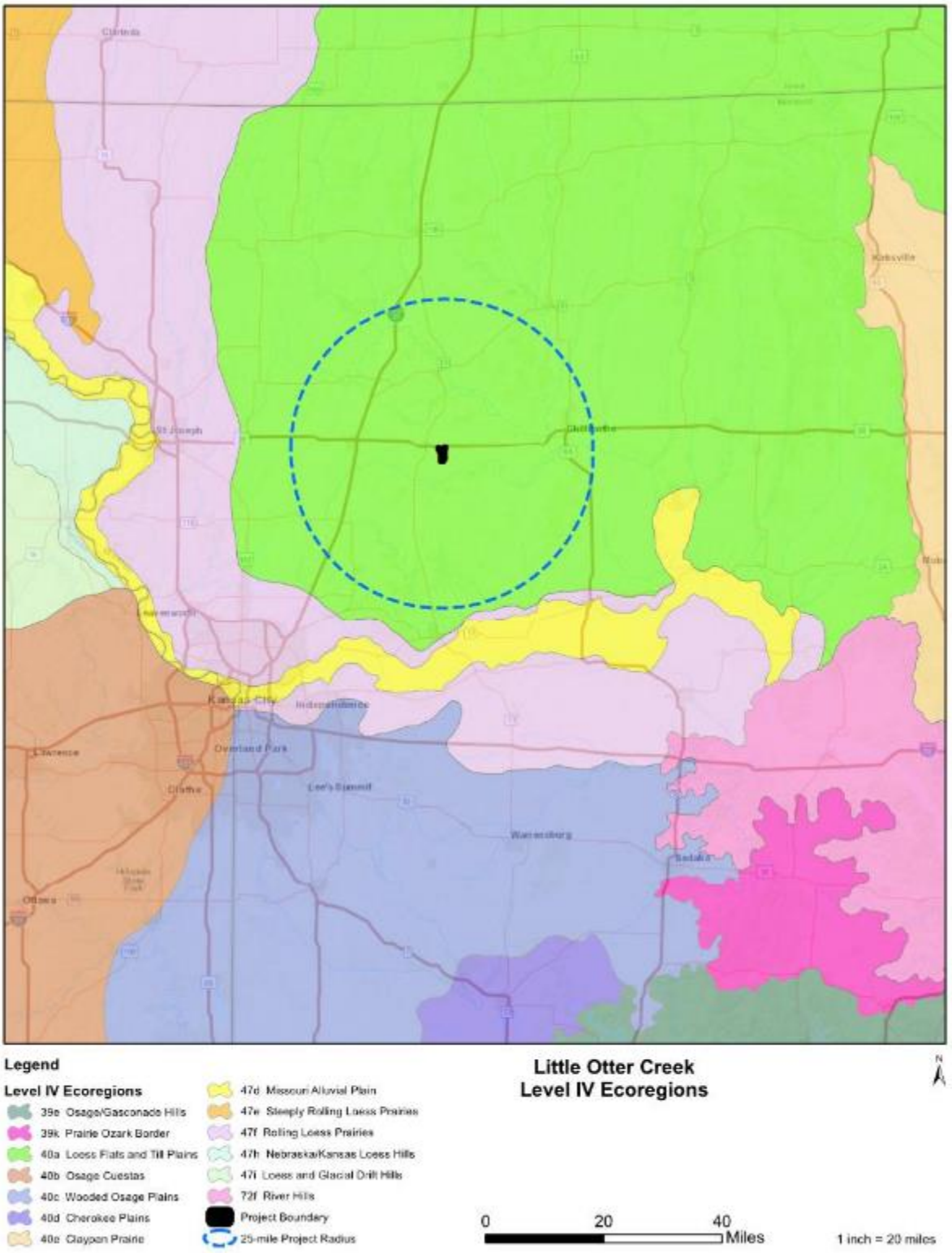


Figure 3.7-1. Level IV Ecoregion (Source: USEPA 2012).

3.7.1 Affected Environment

The project area is within the Loess Flats and Till Plains Level IV Ecoregion (40a). The Loess Flats and Till Plains Level IV Ecoregion is characterized by low hills and smooth plains, with perennial, channelized streams. The geology of this ecoregion includes moderate loess over loamy till and clay loam till, Pennsylvanian sandstone, limestone, and shale. Vegetation is a mosaic of little bluestem-sideoats grama (*Bouteloua curtipendula*) prairie, bur oak woodland, and chinkapin oak woodland (USEPA 2012).

The project study area was noted in 2015 as consisting primarily of vacated agricultural area, with a flowing creek surrounded by patches of riparian forest. Open areas contained a mixture of grasses and fallow fields, while forests were primarily oak and other hardwoods with dense understory vegetation (MSU 2015b). A partial list of species within the riparian corridor included the American elm, American sycamore, black locust, black willow, common hackberry, eastern cottonwood, eastern red cedar, green ash, honey locust, Ohio buckeye, Osage orange, red mulberry, red oak, and silver maple (MSU 2015b).

A follow-up site visit was conducted in 2017. Table 3.7.1-1 provides a partial list of plant species noted during the site visit. Given the size of the project study area, the list of plant species in Table 3.7.1-1 is not all encompassing, but it is representative of common species observed at the time. Pastures include a species mix of tall fescue (*Lolium arundinaceum*), smooth brome (*Bromus inermis*), or a CRP mix dominated by big bluestem (A*ndropogon gerardii*), little bluestem Indiangrass (*Sorghastrum nutans*), and switchgrass (*Panicum virgatum*). Loss of species diversity and introduction of invasive, non-native species is typical of the region.

Table 3.7.1-1. Partial List of Common Plants Observed On-site in 2017.

Common Name	Scientific Name
American elm	*Ulmus americana*
Baldwin's ironweed	*Vernonia baldwinii*
Big bluestem	*Andropogon gerardii*
Black-eyed Susan	*Rudbeckia hirta*
Black locust	*Robinia pseudoacacia*
Black walnut	*Juglans nigra*
Blackberry	*Rubus allegheniensis*
Box elder	*Acer negundo*
Chestnut oak	*Quercus montana*
Coral berry	*Symphoricarpos orbiculatus*
Cottonwood	*Populus deltoides*
Gooseberry	*Ribes missouriense*
Greenbrier	*Smilax hispida*
Hackberry	*Celtis occidentalis*
Honey locust	*Gleditsia triacanthos*
Horseweed	*Conyza canadensis*
Indian grass	*Sorghastrum nutans*
Maximillian sunflower	*Helianthus maximiliani*
Missouri goldenrod	*Solidago missouriensis*
Multiflora rose	*Rosa multiflora*
Ohio buckeye	*Aesculus glabra*
Orchardgrass	*Dactylis glomerata*
Poison ivy	*Toxicodendron radicans*
Pokeweed	*Phytolacca americana*
Purple top	*Tridens flavus*
Red oak	*Quercus rubra*
Showy milkweed	*Asclepias speciosa*
Smooth brome	*Bromus inermis*
Sycamore	*Platanus occidentalis*
Virginia wildrye	*Elymus virginicus*
Western ragweed	*Ambrosia psilostachya*
Wingstem	*Verbesina alternifolia*

3.7.2 Direct and Indirect Effects of No Action Alternative

The No Action alternative would have no impacts on terrestrial vegetation.

3.7.3 Direct and Indirect Effects of the Proposed Action

The Proposed Action would affect terrestrial vegetation in areas of inundation and dam construction. Additional areas would be indirectly affected by a change in land use. Changes in land use would occur either from the direct land purchase by Caldwell County or purchase from individuals or businesses desiring land adjacent to or near a reservoir. None of the terrestrial vegetation species are federally threatened or endangered species.

Disturbance of vegetation for construction activities could result in the introduction of non-native or invasive species into unvegetated areas. BMPs and restoration of vegetation would be incorporated into the project to minimize this potential impact.

3.8 Terrestrial Wildlife

Vegetation removal for construction of the Proposed Action would decrease the amount of upland habitat available in the project area. Mobile species, such as most birds and larger mammals, would be expected to move out of the project area once construction activities commence.

Section 4(d) of the ESA directs the USFWS to issue regulations deemed "necessary and advisable to provide for the conservation of threatened species." The northern long-eared bat was listed as threatened on April 2, 2015. The USFWS published a final Section 4(d) rule in the federal register on January 14, 2016. The listing of the northern long-eared bat as threatened with a 4(d) rule has occurred since preparation of the FEIS and approval of the ROD in May 2003. The northern long-eared bat is discussed in the following section about threatened and endangered species.

Other than the listing of the northern long-eared bat, there has been no substantial change in the affected environment and impact analysis to terrestrial wildlife within the project area since preparation of the FEIS and approval of the ROD in May 2003. No further analysis was completed.

3.8.1 Migratory Birds

Migratory Bird Treaty Act (MBTA)

Under the MBTA (16 U.S.C. 703-712: Ch. 128 *as* amended), construction activities in grassland, wetland, stream, and woodland habitats, and those that occur on bridges (for example, which may affect swallow nests on bridge girders) that would otherwise result in the "taking" of migratory birds, eggs, young, and/or active nests should be avoided. The MBTA regulation defines "take" as "to pursue, hunt, shoot, wound, kill, trap, capture, or collect" or to attempt any of these acts. Although the provisions of MBTA are applicable year-round, most migratory bird nesting activity in Missouri occurs during the period of April 1 to July 15. However, some migratory birds are known to nest outside the primary nesting season period. For example, raptors can be expected to nest in woodland habitats during February 1 through July 15, whereas sedge wrens, which occur in some wetland habitats, normally nest from July 15 to September 10.

Bald and Golden Eagle Protection Act (BGEPA)

In addition to being protected by the MBTA, bald and golden eagles have specific protection under the BGEPA (16 U.S.C. 668-668c.), which is administered by the USFWS. Protections under this act prohibit "take" of bald and golden eagles. Bald eagles use tall trees for roosting or nesting and nearby open water for foraging; golden eagles use shortgrass and mixed-grass prairies for foraging and rock cliffs, tall trees, and other high places for nesting.

3.8.2 Affected Environment

Typical wildlife of the project area includes white tail deer, coyotes, raccoons, opossums, striped skunks, squirrels, snakes, turtles, and frogs. The most common wildlife habitats that would be affected are cultivated cropland, pasture land, and deciduous forest.

The area that would be within the normal pool is currently agricultural fields including croplands and pastures, and deciduous forest. Forested areas, trees, and brush thickets associated with the riparian corridor may provide nesting habitat for nesting migratory bird and eagle species. Further, the Proposed Action and the adjacent forested areas could provide suitable habitat for bald eagles.

3.8.3 Direct and Indirect Effects of the No Action Alternative

The No Action alternative would have no impacts on terrestrial wildlife.

3.8.4 Direct and Indirect Effects of the Proposed Action

Vegetation removal for construction of the Proposed Action would decrease the amount of habitat available in the project area. The deciduous forest may provide nesting, foraging, and cover habitat for many species of birds, raptors, bats, deer, coyotes, and small mammals. The Little Otter Creek watershed comprises an estimated 493 acres of forest land. The Proposed Action would affect an estimated 98 acres of upland forest habitat, which is 20 percent of the forest habitat within the watershed. In addition, pasture land may provide suitable grassland habitat for wildlife.

Given the limited nature of Proposed Action's impact on wildlife habitat and the availability of similar habitat in the general area, the Proposed Action would have a minimal impact on the region's wildlife. Mobile species, such as most birds and larger mammals, would be expected to move out of the project area once construction activities begin. The site would diversify the available habitat for many species by providing a reliable source of water even in drought conditions. The open water habitat and flooded timber could provide habitat for bald and golden eagles that migrate through the area.

3.9 Threatened and Endangered Species

Endangered Species Act

Federally listed threatened and endangered species are protected under the ESA 1973 as amended (16 U.S.C. 1531 et seq.). Adverse effects on a federally listed species or its habitat would require consultation with the USFWS under Section 7 of the ESA. Section 7 of the ESA of 1973, as amended, requires federal agencies to ensure actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of proposed, endangered, or threatened species or result in the destruction or adverse modification of the critical habitats of those species.

Threatened and Endangered Species

Table 3.9-1 identifies state and federally listed threatened and endangered species that may be located within the project study area.

Table 3.9-1. Federal- and State-Listed Species Known from Caldwell County.

Common Name	Scientific Name	Status
Topeka shiner	*Notropis topeka*	Federal and State Endangered
Indiana bat	*Myotis sodalis*	Federal and State Endangered
Northern long-eared bat	*Myotis septentrionalis*	Federal Threatened, State Endangered
Plains spotted skunk	*Spilogale putorius interrupta*	State Endangered

The project study area is located within the Great Plains Ecoregion of Missouri which supports grasslands, few forests, and subhumid to semiarid climates. The project study area is comprised primarily of crop and pasture lands, with small patches of forested areas.

A mist net and acoustic monitoring study was conducted in 2015 at the Proposed Action project location to determine the presence or probable absence of the Indiana bat and the northern long-eared bat. In 2001, the MDC conducted a survey of the fish community to determine the presence of the Topeka shiner. A second Little Otter Creek Topeka shiner survey was completed in October 2015 and covered all 160 pools within the project location and two miles upstream and downstream. The reports are provided in Appendix A.

Topeka shiner

The Topeka shiner is a minnow of small, clear, low-order prairie streams. Historically, the federally listed endangered Topeka shiner occurred in reaches of Shoal Creek. Little Otter Creek flows into Otter Creek which in turn flows to Shoal Creek. USFWS (2013) states this about the range of the Topeka shiner in Missouri:

> "The species once occupied portions of the Missouri, Grand, Lamine, Chariton, Crooked, Des Moines, Loutre, Middle, Hundred and Two, and Little Blue river basins (MDC 2010, p. 10).
>
> "Since 1940, the species has been extirpated from many Missouri River tributaries, including Perche Creek, Petite Saline Creek, Tavern Creek, Auxvasse Creek, Middle River, Moreau River, Splice Creek, Slate Creek, Crooked River, Fishing River, Shoal Creek, Hundred and Two River, and Little Blue River watersheds."

Indiana bat

The Indiana bat is a small, dark brown to black bat that is similar in appearance to many other related species. Indiana bats hibernate during winter in caves or abandoned mines and migrate to wooded areas in the summer where they roost among loose tree bark on dead or dying trees, or on trees with naturally loose bark such as shagbark hickory.

Northern long-eared bat

The northern long-eared bat is a medium-sized bat that is medium to dark brown on the back and tawny to pale brown on the underside. The northern long-eared bat hibernates in caves and mines during the winter, and roosts underneath bark, or in crevices of live or dead trees in the summer.

Plains spotted skunk

The plains spotted skunk is a state endangered species that can be found in open grasslands, brushy areas, and cultivated lands. According to the Missouri Department of Conservation, spotted skunks require some form of cover such as a brushy field border, fencerow, or heavily vegetated gully between the den and foraging areas (MDC 2015). They build their dens below ground in grassy banks, rocky crevices or along fence rows. They area also known to build dens above ground in hay stacks, woodpiles, hollow logs or trees or brush heaps (MDC 2015).

3.9.1 Direct and Indirect Effects of the No Action Alternative

The No Action alternative would not impact threatened and endangered species.

3.9.2 Direct and Indirect Effects of the Proposed Action

The USFWS provided information stating that the Indiana bat and the Topeka shiner, both federally and state-endangered species, may occur in the watershed. Additionally, the northern long-eared bat, a federally threatened and state-endangered species, may occur in the watershed. Surveys were conducted in 2015 to determine the presence or absence of the Topeka shiner, the Indiana bat, and the northern long-eared bat within the project area. In addition, the project area may provide habitat for the state-endangered plains spotted skunk.

Topeka shiner

In 2001, the MDC conducted a survey of the fish community to determine the presence of the Topeka shiner within the study area. A follow-up Topeka Shiner Survey was completed in Little Otter Creek in 2015. The protocol for that survey was developed in coordination with USFWS and sampled all 160 pools within the project location, as well as suitable habitat 2 miles upstream of the normal pool and 2.5 miles downstream of the dam location. Sampling was carried out from October 17 through October 28, 2015. A total of 17 species were collected, none of which were Topeka shiner (Section 3.6.1.1) (MSU 2015a). Species most commonly found were centrarchid (bass and sunfish) species, such as bluegill, spotted bass, and green sunfish; and cyprinid (minnows) species, such as creek chub, central stoneroller, and bluntnose minnow. Shiners collected included sand shiner, bigmouth shiner, red shiner, and redfin shiner, which are considered common within stream drainages that include Little Otter Creek (MSU 2015a). Figure 3.9.2-1 shows the sampling of a typical habitat in Little Otter Creek in 2015. The Proposed Action is not likely to adversely affect Topeka shiner due to its probable absence in the area.

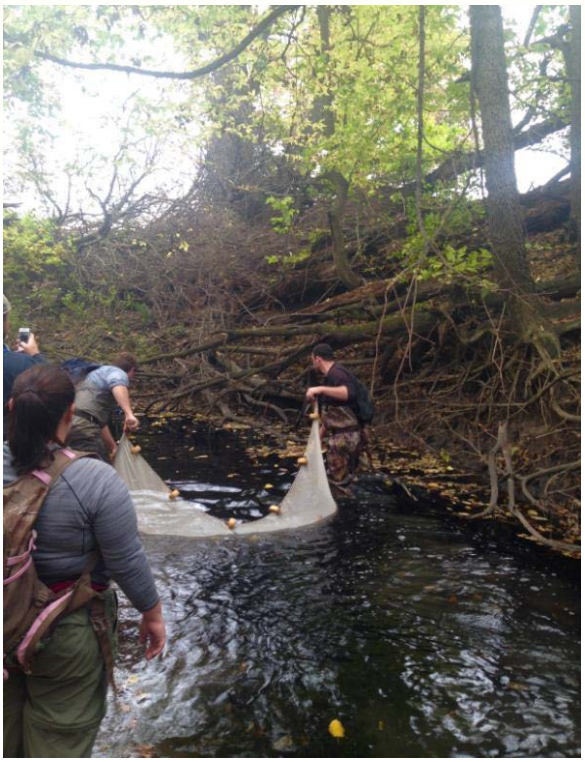


Figure 3.9.2-1. Sampling for Topeka Shiner using a Seine Net in Little Otter Creek (photo from MSU 2015a).

Indiana bat and northern long-eared bat

A mist net survey and acoustic monitoring was conducted in 2015 at the Proposed Action project location. The survey was designed to determine the presence or probable absence of the Indiana bat and the northern long-eared bat. Survey methods were based on the guidelines in the Indiana Bat Revised Recovery Plan and the Draft Recovery Plan (USFW 2007) and the Summer Survey Guidance (USFWS 2015). Seven mist net sites were selected by identifying areas that had favorable bat habitat based on the examination of aerial photos and ground searches (e.g., upland deciduous forest blocks, riparian woodland, streams, or ponds). Mist-nets were set prior to sunset, and opened approximately at sunset each night. Nets remained open a minimum of five hours (MSU 2015b).

Bat calls were also recorded. Anabat II and SongMeter 3 acoustic detectors were set prior to sunset and bat calls were recorded from approximately sunset until 5 hours later. Acoustic data was classified to species using USFWS approved Bat Call Identification Software (BCID) and Kaleidoscope software. Calls of a variety of *Myotis* bat species look similar when analyzed using acoustic data software; therefore, calls identified by software as Indiana bat or northern long-eared bat were visually reviewed to determine if they could be confirmed as those species. Figure 3.9.2-2 shows typical setups of acoustic detectors and mist nets.

Figure 3.9.2-2. Bat Acoustic Detector Setup and Mist Net Setup **(showing typical bat acoustic detector setup [left] and an example of a mist net setup across Little Otter Creek [right]; photos from MSU 2015b).**

The total survey effort was 29 net-nights and 17 detector-nights over the course of 7 days (May 27, May 29 – June 2, June 22). One net-night is defined as one net used for one night. One detector-night is defined as one detector for one night at a specific site.

Twelve bats were captured over the course of the survey, one big brown bat (*Eptesicus fuscus*) and 11 eastern red bats (*Lasiurus borealis*). The big brown bat and the eastern red bat are common bat species that do not have a protected status.

The following bat species were classified by their calls using BCID: big brown bat, silver-haired bat (*Lasionycteris noctivagans*), eastern red bat, hoary bat (*Lasiurus cinereus*), little brown bat (*Myotis lucifugus*), Indiana bat, evening bat (*Nycticeius humeralis*), and tri-colored bat (*Perimyotis subflavus*). The following bat species were classified by their calls using Kaleidoscope identification software: big brown bat, silver-haired bat, eastern red bat, hoary bat, little brown bat, northern long-eared bat, Indiana bat, evening bat, and tri-colored bat. While BCID classified nine calls as Indiana bat calls, none of these could be confirmed during visual examination. Kaleidoscope classified one call as a northern long-eared bat and four calls as Indiana bats, but none of these calls could be confirmed during visual examination.

A conclusion of probable absence of Indiana and northern long-eared bats was determined following the results of the 29 net nights and 17 detector nights within the project study area.

Plains spotted skunk

Suitable spotted skunk habitat is found throughout the project area, as well as throughout Caldwell County. Distribution of the spotted skunk in Missouri is statewide and historically, this species was commonly found in the western half of the state. Species decline appears to be the result of “clean” farming, which eliminates the habitat cover this species requires (MDC 2015). Additionally, the use of pesticides has resulted in a decrease of its primary food source, insects (MDC 2015). Construction and implementation of the Proposed Action will result in the removal of habitat; however, it is not anticipated that the Proposed Action would result in “take” of the spotted skunk as defined by the Wildlife Code of Missouri, 3 CSR 10-4.111, which does not define habitat removal as a form of take.

The MDC (2015) has produced a list of BMPs for reducing impacts to plains spotted skunk during project construction. The following BMPs will be followed during construction activities:

- Limit the use of pesticides and herbicides.
- Avoid burning or clearing fence rows, brush piles, and downed logs or trees where skunks may be present, especially during the late spring and summer months when young skunks may be in dens.
- Where skunks are unwanted, remove scrap lumber piles, hay stacks, and unused farm machinery to eliminate potential skunk habitat.

Coordination with the MDC will be conducted as necessary to minimize potential of unintentional take of the spotted skunk and to ensure compliance with the above mentioned BMPs.

The preferred alternative is unlikely to adversely affect any listed species. No federally listed threatened or endangered species were found to occur within the project area.

3.10 Economic and Social Resources

Economic and social resource issues to be considered for the project include such items as permanent or temporary changes or impacts on travel patterns or accessibility; school districts or their operations (bussing); recreational facilities; police and fire services; highway safety; and impacts on businesses.

3.10.1 Affected Environment

Little Otter Creek watershed is located entirely within Caldwell County, approximately 2 miles southeast of Hamilton, Missouri, and 38 miles northeast of Kansas City, Missouri. The county is primarily an agricultural, rural area with 845 farms, 69 of which are in the Little Otter Creek watershed. The county is approximately 275,000 acres in size, and the Little Otter Creek watershed is a 6,323 acres in size. Caldwell County is an estimated 98 percent privately owned land with 2 percent in federal, state, or local government ownership. I-35 runs north and south immediately west of the county and U.S. Highway 36 is north of the project location. The county seat is Kingston, and other communities include Hamilton, Breckenridge, Kidder, Nettleton, New York, Mirabile, Polo, Cowgill, and Braymer. No incorporated towns are in the Little Otter Creek watershed.

As reported by the Missouri Department of Economic Development, Caldwell County had a labor force of 4,424 in 2015. Unemployment rate in the county was 201 (4.5 percent) that year, compared to 4.5 percent statewide and 4.9 percent nationally. Caldwell County's per capita income (in 2013 dollars) is $21,482. Per capita income for Missouri is $25,649, while the national figure is $28,155 (DED 2015).

Caldwell County's largest employment sectors are education services, health care, and social assistance, which combined employ 809 of 3,938 people (21 percent) working in the county. Other employment sectors and their percentages of workforce are: retail trade, 12 percent; manufacturing, 10 percent; construction, 10 percent; public administration, 9 percent; information, 9 percent; transportation, warehousing, and utilities, 8 percent; agriculture, 7 percent; other, 6 percent; arts, entertainment, and recreation, 5 percent; finance, insurance, and real estate, 5

percent; professional, scientific, and management, 4 percent; and wholesale trade, 2 percent (U.S. Census 2010).

There are no anticipated major socio-political factors that would influence major changes in land use or management or the soil, water, air, plant, or animal resources within the watershed.

U.S. Highway 36 is directly north of the Proposed Action area and will serve as a main route to the Proposed Action from the east and west. State Highway 13 is less than 3 miles west of the Proposed Action and provides access to the site from the north and south. No improvements will need to be made as a result of the project.

3.10.2 Direct and Indirect Effects of the No Action Alternative

The No Action alternative would result in a continuation of the flooding of the 3.8-mile segment of Little Otter Creek, which inundates a majority of the Little Otter Creek floodplain and creates damage to infrastructure, potentially requiring repairs to roads, bridges, and utilities. This damage can result in outages and detours, creating problems for residents of the area, and even potential loss of life. Further, the No Action alternative would not provide a dependable long-term water supply, and therefore would not meet a projected 100-year demand for Caldwell County municipalities and residents.

In addition, the No Action alternative would not provide a recreation opportunity that is currently needed in Caldwell County.

3.10.3 Direct and Indirect Effects of the Proposed Action

The Proposed Action would be built with minimal disruption to the traveling public because traffic would be maintained on the existing major roadways. The site is accessed by U.S. Highway 36 and State Highway 13 from NE Sandstone Drive to the north and NE Jefferson Drive to the south, and off NE Sunset Road to the west and NE State Highway B to the east. These highways would not be affected by the Proposed Action. The project would require the closing of County Roads 110 (NE Ridgeway Road) and 121 (NE Ponderosa Road). The latter is minimally maintained, and ends at County Road 110. There are numerous other county roads that access all properties in the area, and thus there would be no disruption to the transportation network from the project.

School and emergency services routes, truck delivery for manufacturing and businesses, traffic transporting goods and services, and general traffic would be minimally inconvenienced during construction equipment movements and material deliveries. Minimal to no improvements to existing roads would be needed because of the Proposed Action. Long-term impacts of the multipurpose reservoir would be positive, supporting the sustainability of the population and businesses of Caldwell County.

Recreational opportunities and a reliable water supply could increase business development and increase jobs available in the region. Temporary jobs are anticipated to be needed for construction activities.

Reduction in flood damages would likely increase profitability for farmers downstream of the Proposed Action, and reduce costs to residents from repairs to infrastructure, as well as reducing the risk of loss of life and reducing fire insurance premium rates.

3.11 Recreation and Visual Resources

3.11.1 Affected Environment

Over 20 years ago, the MDC identified the need for a public recreation lake in Caldwell County as part of its Public Lakes Program Acquisition and Development Plan (Ryck 1991). A lake in Caldwell County would fulfill the MDC goal of providing close-to-home fishing opportunities for Missouri residents within the region (Ryck 1991).

To support the purpose of the Proposed Action, the need for water-based recreation was quantified by using supply and demand data. The analysis focused on water-based recreation specifically to meet fishing demand.

There are no specific visual resources in the area, such as historic sites or landscapes of special interest.

3.11.2 Direct and Indirect Effects of the No Action Alternative

No significant change in the amount of public or private recreational area is expected without the Proposed Action. The community's desire for additional recreational development would not be addressed.

3.11.3 Direct and Indirect Effects of the Proposed Action

Development of the Proposed Action and recreational facilities would provide much-needed opportunities for fishing and passive recreation. The reservoir would supply an estimated 57,104 annual user-days for fishing and passive recreation. Recreational facilities and fish and wildlife habitat development would include facilities such as parking, restrooms, a hiking trail, a shelter house, a fishing pier (platform), and tree, shrub, and other vegetative plantings. Hunting or trapping may also be available if the sponsors determine those activities would be allowed. Coordination with MDC would determine the recreational facilities created as part of a foreseeable future project. The recreational facilities would be designed and planned in consultation with the MDC and other agencies interested in providing input.

The existing visual resources associated with the project area would change incrementally, but they would be consistent with the existing land use. Construction and operational visual impacts would be limited to the project boundaries.

3.12 Public Safety and Hazardous Materials

Hazardous materials are defined as substances that, because of quantity, concentration, or physical, chemical, or infectious characteristics, may present an imminent threat to public health or the environment if released. Solid wastes are designated as hazardous if they are corrosive, ignitable, explosive, chemically reactive, or toxic, as defined in 40 CFR 261 Subpart C. USEPA and other federal and state agencies regulate hazardous materials under the Toxic Substances Control Act; Comprehensive Environmental Response, Compensation, and Liability Act; Resource Conservation and Recovery Act (RCRA); Superfund Amendments and Reauthorization Act; and Emergency Planning and Community Right-to-Know Act. RCRA gives USEPA the authority to control hazardous waste from the "cradle to grave." This includes the generation, transportation, treatment, storage, and disposal of hazardous waste. RCRA also set forth a

framework for the management of nonhazardous solid wastes. The 1986 amendments to RCRA enabled the USEPA to address environmental problems that could result from underground storage tanks containing petroleum and other hazardous substances. Hazardous wastes are regulated through the MDNR.

3.12.1 Affected Environment

The Proposed Action would be located in a rural section of Caldwell County, in an area largely comprised of agricultural land. The City of Hamilton is located an estimated 2 miles northwest of the project site, and U.S. Highway 36 is directly north of the Proposed Action. The MDNR's *Hazardous Substance Site Locator Map* was reviewed and did not indicate any hazardous waste or material sites in or near the proposed multipurpose reservoir.

Discussions with state government officials uncovered no awareness of leaking underground storage tank sites; treatment, storage, and disposal facilities; Superfund sites; or permitted wastewater treatment facilities in the Little Otter Creek watershed (NRCS 2003). Figure 3.12.1-1 shows the hazardous waste sites within and near the study area.

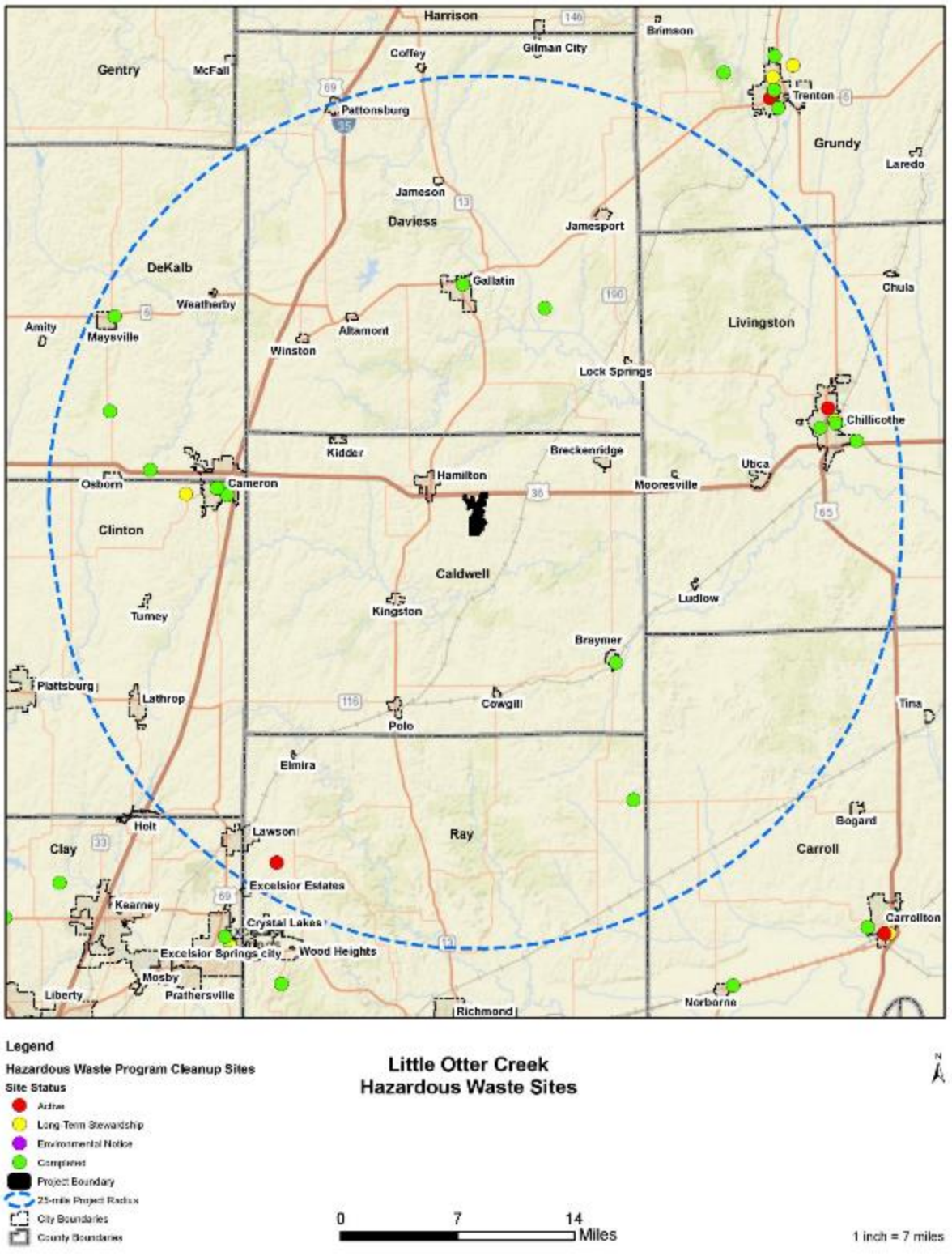


Figure 3.12.1-1. Hazardous Waste Sites near the Study Area.

3.12.2 Direct and Indirect Effects of the No Action Alternative

The No Action alternative would have no impacts on public safety or hazardous materials.

3.12.3 Direct and Indirect Effects of the Proposed Action

Hazardous materials are unlikely to be generated by construction or operation of the proposed multipurpose reservoir. Any potential water quality concerns as a result of adjacent farms or road corridors would result in minimal contamination and would not lead to a hazardous materials issue. There would be no impacts on public health.

3.13 Noise Impacts

3.13.1 Affected Environment

Most of the Proposed Action study area is in a rural environment with agricultural land uses. No noise-sensitive areas (such as residences, schools, churches, or parks) are in the immediate vicinity of the Proposed Action. Highway traffic influences ambient noise levels in these rural areas. Hamilton, Missouri, is northwest of the project study area, and has a variety of land uses that influence ambient noise, including industrial and residential lands.

3.13.2 Direct and Indirect Effects of the No Action Alternative

The No Action alternative would have no noise impacts.

3.13.3 Direct and Indirect Effects of the Proposed Action

No permanent increase in noise is anticipated as a result of the multipurpose reservoir. There would be an increase in traffic on county roads leading to the site both during and after construction, as well as minimal noise from construction equipment during project construction. However, these minimal increases would not have permanent impacts on the area since there are no noise-sensitive areas in the immediate vicinity of the Proposed Action area or along the county roads.

3.13.4 Minerals

3.13.4.1 Affected Environment

Mineral resources identified near the Proposed Action project study area include sand and gravel mining. The locations of the mineral resources were determined using USGS topographic maps, mineral resource databases from the Bureau of Land Management and USGS, and GIS data provided by the Missouri Geological Survey.

3.13.4.2 Direct and Indirect Effects of the No Action Alternative

The No Action alternative would not have an impact on minerals.

3.13.4.3 Direct and Indirect Effects of the Proposed Action

Because of the agricultural nature of the land within the Proposed Action project study area, mineral resources would not be significantly affected by the construction of this Proposed Action.

Additionally, the mineral rights of the land within the project area are now owned by the project sponsor.

3.13.5 Soils

3.13.5.1 Affected Environment

The watershed lies within Major Land Resource Area 109 – Iowa and Missouri Heavy Till Plain. Upland topography consists of nearly level to sloping, rounded ridgetops and gently sloping to moderately steep sideslopes. Nearly level to flat floodplain areas are located along the mainstream channel of Little Otter Creek and its tributaries. Local relief is an estimated 73 meters (239 feet) with elevations ranging from 300 meters (984 feet) National Geodetic Vertical Datum in the northwestern portion of the watershed to 227 meters (745 feet) at the watershed outlet (NRCS 2003).

The published soil survey of Caldwell County (USDA-SCS 1974) lists the following soil associations within the watershed boundaries:

1. Lagonda-Grundy: Lagonda soils are on the ridges, the upper parts of hillsides, and around the heads of small drainageways. They formed in loess over glacial till. Grundy soils occupy the higher parts of high, rounded ridges and formed in loess deposits. Slopes range from 2 to 9 percent. Minor soils in this association include: Lamoni, Adair, Armster, Kennebec, Blackoar, and Zook.
2. Armster-Lineville: Armster soils occupy the lower parts of hillsides and formed in glacial till. Lineville soils are on ridges and upper hillsides in uplands and formed in loess overlying glacial tills. Slopes range from 2 to 20 percent. Minor soils in this association include: Ladoga, Sampsel, Snead, Greenton, Rock land, Kennebec, Zook, Moniteau, and Nevin.
3. Sampsel-Greenton-Snead: Sampsel soils are mostly on the lower parts of hillsides and formed in residuum weathered from shales. Greenton soils are on hillsides and the end of ridges on uplands and formed in residuum from interbedded shales and limestones. Snead soils are on hillsides and formed on weathered materials from interbedded shales and limestones. Slopes range from 2 to 20 percent. Minor soils in the association include: Lagonda, Armster, Lineville, Rock land, and Kennebec.
4. Kennebec-Zook: Kennebec soils are on floodplains and gently sloping footslopes and formed in silty alluvium. Zook soils are in swales, old stream channels, and other depressional areas on bottomlands and formed in fine-textured alluvium. Slopes are level to nearly level. Minor soils in the association include: Blackoar, Colo, Nevin, Moniteau, Armster, and Sampsel.

Figure 3.13.5.1-1 shows the hydric soils in the Proposed Action project study area.

Figure 3.13.5.1-1. Hydric Soils in the Proposed Action Area.

3.13.5.2 Direct and Indirect Effects of the No Action Alternative

Ongoing and future conservation programs will address erosion and sedimentation concerns within the watershed. Prior to any construction, NRCS is required to certify that at least 75 percent of the cropland in the watershed contributing to the preferred alternative has been treated to "T" (the tolerable level of soil loss) or below. Gully and streambank erosion rates are expected to be reduced as conservation practices are installed on the landscape.

3.13.5.3 Direct and Indirect Effects of the Proposed Action

The Proposed Action will provide grade stabilization benefits which would help reduce any potential gully erosion and streambank erosion along Little Otter Creek. The eroding stream reach would be stabilized by the reservoir's permanent pool, and therefore reduce sediment delivered to downstream reaches. Average annual sediment transport at the confluence with Otter Creek is estimated to be reduced from approximately 13,300 tons to 3,700 tons. (NRCS 2003).

3.14 Cultural Resources

Section 106 of the National Historic Preservation Act, as amended, and implementing regulations found at 36 CFR Part 800, require that federal agencies consider any effect a proposed action may have on historic properties.

Cultural resources generally include archaeological sites, historic properties, traditional cultural places, and other places where significant historic activities have taken place. These sites are often considered valuable to the human environment, and measures must be taken to ensure they are treated appropriately.

Congress passed the American Indian Religious Freedom Act of 1978 (PL 95-341) to protect and preserve for American Indians their inherent rights of freedom to believe, express, and exercise their traditional religions including, but not limited to, access to sites, use and possession of sacred objects, and the freedom to worship through ceremonial and traditional sites. Therefore, the law requires that the effects of a federal undertaking on Native American sites or places (prehistoric or historic) that have religious, ceremonial, or sacred aspects be evaluated within the context of this law.

The Native American Graves Protection and Repatriation Act was passed in 1990 and describes "the rights of Native American lineal descendants, Indian tribes, and Native Hawaiian organizations with respect to the treatment, repatriation, and disposition of Native American human remains, funerary objects, sacred objects, and objects of cultural patrimony, referred to collectively in the statute as cultural items, with which they can show a relationship of lineal descent or cultural affiliation" (NPS 2016).

3.14.1 Affected Environment

While no archaeological sites have been recorded within the Little Otter Creek watershed, prehistoric sites have been recorded along major drainages in the area. European settlers first moving into Caldwell County in the early 1800s noted that the Iowa and Kickapoo tribes used the area as hunting grounds. Caldwell County was organized in 1836, with a county seat at Far West. The population of the county quickly increased to nearly 7,000 as the county became the

home of the Mormons. Tensions between the Mormon and non-Mormon populations increased, culminating in late 1838 in a period known locally as the "Mormon War" and the movement of most Mormons out of the county (NRCS 2003).

The National Register of Historic Places (NRHP) lists two sites in Caldwell County—the Caldwell County courthouse and the old town site of Far West. Neither site is within the watershed boundaries.

A cultural resources review was conducted for the Proposed Action by the Missouri Cultural Resources Specialist (CRS). The CRS and two assistants conducted a review that included a field survey of more than 300 acres of proposed dam and pool areas. The 2003 cultural resources survey was reviewed by a professional archaeologist and supplemented with field investigations in 2017 in consultation with the Missouri SHPO (Campbell, 2017). Known historic properties (such as Haun's Mill, which is located about 6 miles southeast of the Proposed Action site) would not be affected by the Proposed Action.

There are no tribal lands in Missouri, and Caldwell County was not listed as an area of interest in the Native American Consultation Database.

Six potentially interested tribes were informed of the project in a letter from NRCS State Conservationist J.R. Flores, dated September 22, 2010, and were invited to comment. Only the Osage Nation responded with a request for a copy of the Phase I Cultural Resources Survey. NRCS replied on November 9, 2010, that the agency was collecting additional information and would provide it when completed. NRCS provided the Osage Nation with a copy of the Section 106 survey in a letter dated June 17, 2011 and requested comments within 30 days. NRCS received delivery confirmation but did not receive a response from the Osage Nation. NRCS contacted the Osage Nation again by letter in December 2017. The Osage Nation replied in a letter dated February 9, 2018 that they had determined that the proposed action "most likely will not adversely affect any sacred properties and/or properties of cultural significance to the Osage Nation." Their finding is a determination of "No Properties" eligible or potentially eligible for the National Register of Historic Places.

3.14.2 Direct and Indirect Effects of the No Action Alternative

The No Action alternative would have no impact on cultural resources.

3.14.3 Direct and Indirect Effects of the Proposed Action

The Proposed Action will have no impacts on known cultural resources. If any areas of cultural or ancestral interest are found during construction, the local sponsor will immediately halt construction and contact the NRCS cultural resources specialist, the Missouri SHPO and the appropriate tribal representatives and initiate any necessary consultation prior to further construction.

3.15 Environmental Justice

President Clinton signed Executive Order (EO) 12898, *Federal Actions to Address Environmental Justice in Minority and Low-Income Population*, in 1994. This EO focuses the attention of federal agencies on human health and environmental conditions in minority and low-income communities. Environmental justice analyses are performed to identify the potential for disproportionately high

and adverse impacts on minority and low-income populations from proposed actions, and to identify alternatives that might mitigate these impacts.

The analysis of environmental justice impacts relies primarily on 1997 definitions as follows:

- Low-income populations in an affected area should be identified with the annual statistical poverty thresholds from the U.S. Census Bureau Current Population Reports.
- Minority individuals are defined as members of the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic. A minority population should be identified where either (a) the minority population of the affected area exceeds 50 percent or (b) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis (CEQ 1997). Note: The 2000 census updated minority definitions to include the following: Black or African American; American Indian or Alaska Native; Asian; Native Hawaiian or other Pacific Islander; some other race; and two or more races (U.S. Census 2001).

Minority populations included in the census are identified as Black or African American, American Indian and Alaska Native, Asian, Native Hawaiian and other Pacific Islander, some other race, and two or more races. Hispanic or Latino populations, which can be of any race, are also considered. Poverty status, used in this SEIS to define low-income status, is reported as the number of people with income below the poverty level. The 2010 census defines the poverty level as a weighted average threshold of $11,139 or less for an individual and a weighted average threshold of $22,314 or less for a family of four (U.S. Census 2010). The poverty-weighted average threshold for a family of four in 2011, the latest year available, was $23,201 (U.S. Census 2010). However, demographics and income data from the 2010 Census of Population and Housing were used for portions of this analysis. Data from the 2000 and 2010 census are the latest reliable and consistent data regarding the ethnic composition and poverty status of the population, especially for subcounty divisions such as towns. Later estimates from various sources may use different methodologies and do not provide accurate comparisons.

These definitions and assessment methodologies follow the CEQ Environmental Justice Guidance under the NEPA (CEQ 1997).

The Project Sponsor, Caldwell County, hosted project update meetings throughout the development of the project. The meetings were noticed in the local paper or at the County Courthouse, and members of the public were invited to attend. Attendees included staff from regulatory agencies, staff representatives of state and federal congressional delegations, as well as members of the public. Section 7.0 provides public outreach information and meeting dates. Discussions at the public meetings included progress of the SEIS, efforts related to the SEIS, funding, and other project considerations. Public input, if received, was considered in the planning of the project.

3.15.1 Affected Environment

The Proposed Action is in a rural part of Caldwell County, in an area largely comprised of agricultural land. The City of Hamilton is located an estimated 2 miles northwest of the project site, and U.S. Highway 36 is directly north of the Proposed Action project site.

According to the U.S. Census Bureau's 2010 Census, the population of Caldwell County was 9,424 and the watershed population was 237 (using the nearest spatial approximation of the watershed via census blocks). Sixteen percent of Caldwell County's population is over the age of 65, compared to 13.7 percent for the state of Missouri and 12.7 percent for the nation. Caldwell County's population is 97.4 percent White, 0.2 percent American Indian, 0.7 percent African American, 0.3 percent Asian, 0.0 percent Native Hawaiian or Pacific Islander, 1.4 percent identified by two or more races, and 1.3 percent identified as Hispanic (U.S. Census 2010).

Table 3.15.1-1 shows race and ethnicity for Caldwell County, Missouri, and the United States in 2010. An estimated 2.6 percent of the population in Caldwell County was of ethnic minorities, compared to 16.6 percent for Missouri and 26.0 percent for the U.S. Caldwell County's Hispanic population was 1.3 percent, Missouri's was 3.4 percent, and the United States' was 15.7 percent.

Table 3.15.1-1. Minority Population in the Proposed Action Vicinity.

	Caldwell County	Missouri	United States
White	97.4	83.4	74.0
Black or African American	0.7	11.5	12.5
American Indian and Alaska Native	0.2	0.4	0.8
Asian	0.3	1.6	4.7
Native Hawaiian and Other Pacific Islander	0.0	0.1	0.2
Some Other Race	0.1	1.0	5.5
Two or More Races	1.4	2.1	2.4
Hispanic or Latino (of any race)	1.3	3.4	15.7

Source: U.S. Census 2010

As of 2010, the percentage of individuals below the poverty level in the Caldwell County was 15.9 percent, which is higher than the percentage of individuals below the poverty level in Missouri (14.0 percent) and the United States (13.8 percent). Table 3.15.1-2 shows age and income in the Proposed Action vicinity.

Table 3.15.1-2. Age and Income in the Proposed Action Vicinity.

2010 Demographic Age and Income Statistics			
	Caldwell County	**Missouri**	**United States**
Number			
65 years of age and over	1,556	812,724	38,749,413
Individuals below poverty level	1,455	802,596	40,917,513
Percentage			
65 years of age and over	16.6	13.7	12.7
Individuals below poverty level	15.9	14.0	13.8
Income			
Median household income	$51,231	$57,661	$62,982
Per capita income	$19,499	$24,724	$27,334

Source: U.S. Census 2010, American Community Survey

3.15.2 Direct and Indirect Effects of the No Action Alternative

Caldwell County consistently has a higher percentage of population below the poverty level, as compared to the state and the national data, and has a high cost of water because of limited water supply. The No Action alternative would not benefit a protected population.

3.15.3 Direct and Indirect Effects of the Proposed Action

This alternative would provide reliable and predictable costs of water, an essential component for life and quality of life for a protected population. There are no anticipated environmental justice factors that would influence major changes in land use or result in disproportionately negative impacts on minority or low-income populations. All purchases of land were made from willing sellers and were completed in accordance with the Uniform Relocation Act, as would any additional land purchases. The Proposed Action would provide a recreational benefit to the surrounding communities and countywide.

4.0 Cumulative and Growth-Inducing Effects

4.1 Cumulative Effects Boundaries

The cumulative effects boundaries include effects from past, current, and reasonably foreseeable future projects in Caldwell County related to the project purposes of water supply, recreation, and flood damage reduction**.**

4.2 Past, Present, and Reasonably Foreseeable Future Projects

4.2.1 Other Federal Project Activities

No additional federal projects are planned in Caldwell County in the foreseeable future.

4.2.2 Other Local Projects

Other local projects in the foreseeable future include a water treatment plant and distribution lines that would be required during the 100-year life of the reservoir. Additionally, development of recreational facilities around the impoundment may occur in coordination with MDC. Conceptual designs have not been completed for recreational facilities. No new known business or residential developments have been planned or platted in the project vicinity.

4.3 Cumulative Effects Analysis

Note that direct and indirect impacts were addressed for each resource in Chapter 3. This section addresses cumulative impacts caused by known past private or public projects and impacts that could be caused by foreseeable future private or public projects.

4.3.1 Climate

The completion of foreseeable future projects would not have a cumulative effect on the climate of the Little Otter Creek watershed or on Caldwell County.

4.3.2 Land Use

To manage any potential new activity that may occur surrounding the lake, the County Commission has developed a L-1 Lake District development zone surrounding the lake. The 1,630 acre district includes the reservoir and all Commission owned property, plus an additional 708 acres of adjacent ground. To protect lake water quality, the zone is regulated to allow continued moderate impact agricultural use, recreational and/or large lot residential uses and prohibits CAFOs, landfills etc. Livestock is limited to personal use and consumption only. On-site sanitary sewer facilities are required to be designed and installed by qualified professionals in full compliance with all state laws.

The 708 acres of privately owned property in this zone is 53.5% cultivated crops, 34.9% pasture/hay, 5.3% developed and 4.8% deciduous forest according to the 2011 NLCD. The remaining 1.5% is open water and grassland/herbaceous. The L-1 zoning district contains an additional 350 acres of land designated as prime farmland and 40 acres of land designated as farmland of statewide importance.

4.3.2.1 Farmland Resources

There are 104 acres of land currently being farmed within the project footprint. According to the NRCS Soil Survey (2017), an estimated 186 acres of land designated prime farmland and 24 acres of designated farmland of statewide importance is within the project footprint and would be inundated by the Proposed Action. This represents 33 percent of the total prime farmland and 4.8 percent of the farmland of statewide significance within the watershed. In addition to the project footprint, land purchased by the County for the project contains an additional 140 acres of land designated as prime farmland and 103 acres of land designated as farmland of statewide importance that is not directly affected by the Proposed Action. The L-1 zoning district surrounding the proposed action includes an additional 350 acres of land designated as prime farmland and 40 acres of land designated as farmland of statewide importance. Although there are no planned or platted developments currently proposed, the development of the lake may lead to additional loss of farmland if future developments occur.

4.3.2.2 Forest / Woodland Resources

Past forest changes include expansion of deciduous forest into upland areas as prairie fires were controlled, and the clearing of upland forest areas for fuel, particularly during the Great Depression of the 1930s. Foreseeable future projects could affect forest resources for construction of distribution pipelines or the water treatment plant. Recreational facilities would generally avoid affecting forest resources since forest resources are aesthetically pleasing for recreational activities. Relocation of some existing roads and utilities could result in small amounts of tree clearing. There could also be a small amount of tree removal if residences are built nearby. The L-1 zoning district surrounding the proposed action includes 4.8% deciduous forest, which occurs mostly in existing drainage ways. As such, it is unlikely to be impacted except by driveway crossings.

4.3.2.3 Residential

The location of the Proposed Action is in rural Caldwell County and is not near any residential communities. Although it is not anticipated that the Proposed Action would lead to residential growth in the project study area, land directly adjacent to the Proposed Action may see an increase in residential development. In anticipation of the project, the County has enacted a 1,630 acre special zoning district around the lake, within which residential development is allowed, but with a minimum lot size of 5 acres to avoid high density development. The zoning also establishes restrictions for on-site sewer systems. The increase in a reliable water source may increase business demand, resulting in a future increase of residential development.

4.3.2.4 Commercial / Industrial / Infrastructure / Utilities / Other

There are no known projects that would result in additional impacts to infrastructure or utilities. The Proposed Action is located near existing roadways that can handle anticipated recreational traffic, and no substantial impacts to utilities are anticipated.

Infrastructure is needed to meet the water supply needs and water treatment capacity for Caldwell County. This includes the construction of a water treatment plant and water distribution pipelines.

4.3.3 Water Resources

4.3.3.1 Streams

There have been very few past impoundments in the Little Otter Creek watershed, except for a few small farm ponds. However, changes in land use have affected streams, particularly during the periods of EuroAmerican exploration and settlement. The first such change was the extirpation of the North American beaver (*Castor canadensis*) from the region. The beaver would have maintained chains of beaver ponds along many of the smaller side tributaries, and even along the main stem of Little Otter Creek in the project vicinity, with some of these ponds potentially reaching a substantial size (Burchsted et al. 2010). The second such change was the removal of much of the native prairie vegetation on dryland areas in the watershed and replacing it with cultivated row crops and other farming activities (Schroeder 1982). This increased the rate of surface runoff into the streams. These two changes in land use resulted in more erosion and incising of streams in the region.

The Proposed Action would have immediate direct impacts on streams within the normal pool. After avoidance and minimization, unavoidable impacts to aquatic resources will be mitigated under a compensatory mitigation plan approved by the USACE. The potential water treatment plant is anticipated to avoid stream impacts, although water transmission lines may result in temporary impacts. Relocation of existing roads and utilities could result in temporary impacts as well.

4.3.3.2 Groundwater

Though registered wells are located near the project area, the Proposed Action relies on surface water and would not have a cumulative impact on groundwater in this area.

4.3.3.3 Wetlands

Figure 3.13.5.1-1 shows the extent of hydric soils in the project area. Hydric soils are soils that developed under wetland hydrologic conditions, but as can be seen from the AJD, the current extent of wetlands is far less than the extent of hydric soils.

It has been estimated that almost 90 percent of Missouri's wetlands have been lost through a variety of man-made activities, mostly from agricultural activities, but also from other types of development (Epperson 1992). As mentioned in section 4.3.3.1 on stream cumulative impacts, the extirpation of beavers and the loss of beaver dams has been an additional substantial cause of wetland loss. According to Burchsted et al. (2010), "Under modern conditions, beaver dams create dynamic sequences of ponds and wet meadows among free-flowing segments. One beaver impoundment alone can exceed 1,000 meters along the river, flood the valley laterally, and fundamentally alter biogeochemical cycles and ecological structures."

The Proposed Action would affect an estimated 4.1 acres of wetland. After avoidance and minimization, unavoidable impacts to wetlands would be mitigated in accordance with a compensatory mitigation plan approved by the USACE. Mitigation measures are discussed further in Section 5.5.

No other future projects are known that would significantly impact wetlands and create wetland losses. Future development, including construction of water transmission lines, could affect wetlands, but those projects would obtain permits and mitigate for impacts. Recreational development and the water treatment plant are anticipated to avoid wetland impacts.

4.3.3.4 Water Quality

Past agricultural development has resulted in degraded water quality in some parts of the region. The Proposed Action is anticipated to trap sediment and toxicants from the stream system. There are no foreseeable future projects which are likely to affect water quality.

The Proposed Action and associated ecological flow plan would control the release of water to downstream sections, in turn buffering these sections from the impacts of climate change. BMPs would be followed during construction activities to mitigate project impacts to water quality.

4.3.4 Aquatic Resources

4.3.4.1 Fisheries

The Proposed Action would provide recreational fishing opportunities to the residents of Caldwell County. See the purpose and need section of this document for the recreational demand. Lakes in Missouri provide habitat for catfish, bass, crappie, and blue gill, among other species. Foreseeable future projects are not anticipated to have cumulative impacts on fisheries.

4.3.5 Terrestrial Vegetation

The completion of the Proposed Action and foreseeable future projects are not anticipated to have a cumulative impact on terrestrial vegetation.

4.3.6 Terrestrial Wildlife

The Proposed Action may provide habitat to waterfowl and shorebirds as a migratory stopover during spring and fall migration. No other known projects are likely to result in cumulative impacts to wildlife or waterfowl.

4.3.7 Threatened and Endangered Species

The Proposed Action and foreseeable future projects are not anticipated to have a cumulative effect on threatened and endangered species.

4.3.8 Economic and Social Resources

The lack of a reliable water supply in the past may have affected residential and business use in Caldwell County. The completion of the Proposed Action has the potential to increase the economic vitality of Caldwell County by providing a reliable water supply. Increased business development in Caldwell County could occur with a reliable water source. Recreational opportunities could also increase economic development.

MDNR has estimated 96 jobs and $2.5 million in annual economic impact would occur over the first six years of the Proposed Action (Graves 2017).

4.3.9 Recreation and Visual Resources

The completion of the Proposed Action would have a positive cumulative impact on recreation in the Little Otter Creek watershed and in Caldwell County as there is a deficit of supply to meet demand for water-based recreation. Recreational facilities are anticipated to be constructed in coordination with MDC.

No cumulative impacts to visual resources are anticipated with the Proposed Action or with foreseeable future projects.

4.3.10 Public Safety and Hazardous Materials

The completion of the Proposed Action and foreseeable future projects would not have a cumulative impact on public safety and hazardous materials.

4.3.11 Noise Impacts

Because of the nature and size of the reservoir, boats on the reservoir would be small fishing boats, and nonmotorized canoes and kayaks, and would not be large noise producers. No-wake boating is the only type that will be allowed. There would be an increase in traffic on county roads leading to the site both during and after construction and minimal noise from construction equipment during project construction; however, the completion of the Proposed Action would not have a cumulative impact on noise.

4.3.12 Geologic Resources

4.3.12.1 Geology

There would be no cumulative impacts on geology as a result of the Proposed Action or foreseeable future projects.

4.3.12.2 Minerals

Because of the agricultural nature of the land within the Proposed Action area, mineral resources would not be significantly affected by the construction of this Proposed Action. Therefore, the Proposed Action and foreseeable future projects would not have a cumulative impact on minerals.

4.3.12.3 Soils

With appropriate erosion control methods, the Proposed Action would not have a cumulative impact on soils. Soils loss is likely during construction activities. The construction activities would follow a SWPPP.

4.3.13 Cultural Resources

The completion of the Proposed Action and foreseeable future projects are not anticipated to have a cumulative impact on cultural resources.

4.4 Growth-Inducing Effects

The Proposed Action would create an improved water supply for the residents and businesses of Caldwell County, therefore aiding in the retention and attraction of businesses and residents. A stable water supply could attract new businesses that need a reliable, low-cost water supply to operate. Adding new businesses and retaining existing businesses can help support and grow the current population.

In addition to the water supply, recreational activities are anticipated to cause growth-inducing effects. Increased growth in the area as a result of new recreational opportunities is typically associated with new businesses providing recreational goods and services to visitors and

residents of Caldwell County who would be using the recreational amenities resulting from the Proposed Action.

Flood damage reduction downstream of the Proposed Action could increase profitability of agricultural producers through reduced insurance needs, reduced crop loss, and reduced damages to fences, terraces, and roads.

The growth-inducing effects are anticipated to be highest around the Proposed Action, including Hamilton, Missouri, and extend throughout Caldwell County. Currently there are no known residential, commercial, industrial, or agribusiness plans for relocation or expansion within the County. The growth-inducing effects, if they occur, are likely to happen over an extended period of time. They will be limited to activities allowed in the L-1 zoning district, described in section 4.3.2.

5.0 Comparison of Alternatives

5.1 Section 404(b)1 Guidelines Aquatic Impact Factors

In accordance with Section 404(b)(1) Guidelines, aquatic impact factors must be defined to identify potential impacts to wetlands and streams. Potential impacts to other environmental factors must also be identified and defined. The following factors, which are from the *Guidelines for Preparation of Analysis of Section 404 Permit Applications Pursuant to the Section 404(b)(1) Guidelines of the Clean Water Act*, were used to analyze the potential environmental impacts associated with the construction of the Proposed Action. In addition to these factors, social and economic resources were also considered in the analysis of alternative impacts. Mitigation methods other than the Missouri Stream Mitigation Method may be used.

a. Stream Impacts (quantitative). Describe the type(s) of stream impacts that would result from construction of the project and the linear feet of stream that would be affected.
b. Stream Function (qualitative). Describe the quality of the stream(s) that would be affected and the assessment method used to determine stream quality. For the purposes of this assessment, overall loss in stream function that would result from construction of the project on each site is evaluated and rated as high, medium, or low. The functional loss rating is to be based on the linear feet of stream(s) that would be affected and the quality of the stream(s) affected. The rationale for the stream function loss rating given to each site must be discussed.
c. Wetland Impacts (quantitative). Describe the type(s) of wetland impacts that would result from construction of the Proposed Action and the acres of wetland that would be affected.
d. Wetland Function (qualitative). Describe the quality of the wetland(s) that would be affected and the assessment method used to determine wetland quality. For the purposes of this assessment, overall loss in wetland function that would result from construction of the project on each site is evaluated and rated as high, medium, or low. The functional loss rating is to be based on the acres of wetland(s) that would be affected and the quality of the wetland(s) affected. The rationale for the wetland function loss rating given to each site must be discussed.
e. Impacts to Other Waters (quantitative). Describe the type(s) of ditch, open water, etc., impacts that would result from construction of the project and the quantity of other waters that would be affected.
f. Other Waters Function (qualitative). Describe the quality of the waters that would be affected and the assessment method used to determine quality. For the purposes of this assessment, overall loss in aquatic function that would result from construction of the project on each site is evaluated and rated as high, medium, or low. The functional loss rating is to be based on the quantity of waters that would be affected and the quality of the waters affected. The rationale for the aquatic function loss rating given to each site must be discussed.
g. Federally Listed Threatened or Endangered Species. If federally listed species are within the Proposed Action's geographic area for review, each alternative site must be reviewed for the potential for threatened or endangered species to be present, or for the presence of suitable habitat for the listed species.

h. Cultural Resources. If sites listed as eligible or potentially eligible for listing in the NRHP within the proposed project's geographic area for review, each alternative site must be reviewed for cultural resources.

5.2 Comparative Impacts of Alternatives

The comparative impacts of the No Action alternative and the Proposed Action are included in Table 5.2-1.

Table 5.2-1. Comparative Impacts.

Environmental Factors	No Action Alternative	Proposed Action
Stream Impacts	Continued erosion	36,243 feet
Loss in Stream Function	None	Negative Impact – High
Wetland Impacts	None	4.1 acres
Loss in Wetland Function	None	Negative Impact– High
Federally Endangered Species	None	None
Cultural Resources	None	None
Social and Economic	Negative	Positive Impact – High

5.3 Irreversible and Irretrievable Environmental Changes

Irreversible and irretrievable environmental changes from the implementation of the Proposed Action (because of inundation) would include the loss of 36,243 feet of streams, 4.1 acres of wetlands, 104 acres of farmland, and an estimated 98 acres of upland forest.

5.4 Unavoidable Adverse Effects

Unavoidable adverse effects would include stream impacts to 36,243 feet of streams and 4.1 acres of wetlands.

5.5 Mitigation Measures

The USACE completed an approved jurisdictional determination (AJD) in 2010, which was reissued in 2015 (USACOE 2010). Results of the AJD concluded that 4.1 acres of palustrine emergent (PEM) and palustrine scrub shrub (PSS) wetlands would be affected by the dam and the normal pool. Stream impacts were determined to be a total of 36,243 linear feet, including 20,220 lineal feet of perennial stream, 14,569 feet of intermittent streams, and 1,454 linear feet of ephemeral streams (USACE 2010).

Mitigation is necessary and appropriate to compensate for the impacts for the irreversible and irretrievable environmental changes and unavoidable adverse effects. Following all avoidance and minimization efforts, the remaining unavoidable impacts will be addressed as follows.

The project team will explore an overarching mixture of mitigation approaches that includes a combination of permittee responsible mitigation projects, participation in an in-lieu fee programs and purchasing of credits from an established mitigation banks.

Opportunities to collaborate with conservation planners on priority landscapes throughout the Grand River basin, including the Upper Grand (10280101), Thompson (10280102) and Lower Grand (10280103) HUC-8 watersheds which are all in the Central Plains/Grand/Chariton EDU, will be sought out with an emphasis on aquatic organism passage (AOP) issues, grade control, and riparian restoration and enhancement. The Missouri Stream Mitigation Method will be used as a guide to develop appropriate stream mitigation objectives, but we are optimistic that by collaborating closely with stakeholders at the watershed scale they will help us to find a cost effective mitigation plan that most closely aligns with watershed priorities. Watershed priorities will be represented by a variety of NGOs and agencies including Ducks Unlimited, The Conservation Fund, MDNR, MDC and USFWS. Upon completion, mitigation sites will be monitored for five years and protected through appropriate legal assurances such as conservation easements. It is likely that the eight acres of wetland credits will be purchased from an approved wetland mitigation bank.

5.5.1 Air Quality

Construction of the Proposed Action would result in temporary air quality impacts as a result of construction activities. Construction of the Proposed Action is subject to implementation of control measures (or BMPs) to minimize the impacts. Construction emissions control measures may include but are not limited to:

1. Unpaved access roads shall be watered to reduce dust.
2. All haul trucks transporting soil, sand, or other loose material off-site shall be covered.
3. All vehicle speeds on unpaved roads shall be limited.
4. All roadways, driveways, and sidewalks to be paved shall be completed as soon as possible. Building pads shall be laid as soon as possible after grading unless seeding or soil binders are used.
5. Vegetative ground cover (e.g., fast-germinating native grass seed) shall be planted in disturbed areas as soon as possible and watered appropriately until vegetation is established.
6. Idling times shall be minimized either by shutting equipment off when not in use or the minimizing the idling time.
7. Sandbags or other erosion control measures shall be installed to prevent silt runoff to public roadways from sites with a slope greater than one percent.
8. Clear signage shall be provided for construction workers at all access points.
9. All construction equipment shall be maintained and properly tuned in accordance with manufacturer‘s specifications. Requiring that all construction equipment, diesel trucks, and generators be equipped with Best Available Control Technology for emission reductions of NOx and PM.
10. Post a publicly visible sign with the telephone number and person to contact at the lead agency regarding dust complaints. The Air Pollution Control Program ‘s phone number shall also be visible to ensure compliance with applicable regulations.

5.5.2 Forest/Woodland Resources

Construction of the proposed reservoir would inundate an estimated 98 acres of riparian forest. Mitigation of this impact would be completed through the establishment of hardwoods in a

mitigation area adjacent to the reservoir or with easements along the stream channel below the reservoir. Mitigation of upland forest impacts would be coordinated with MDC and the USFWS.

5.5.3 Residential and Business Relocations

Acquisition of all residential and business properties, if required, would comply with the Uniform Relocation Act of 1970. No occupied residences or businesses will require relocation. One abandoned residential structure that is above proposed top of dam was acquired at the original owner's request as part of the negotiated settlement. The Commission is considering the fate of the structure.

5.5.4 Streams

Mitigation measures for the 36,243 linear feet of stream that would be lost because of inundation could include purchase of mitigation credits from a mitigation bank or an in-lieu fee program; or implementation of permittee-responsible mitigation measures within the Little Otter Creek watershed or adjacent watersheds. Minimization efforts include an ecological flow plan that releases water at a magnitude, frequency, duration, timing and rate of change to mimic natural flows and would be a component of measures needed to mitigate the impacts to Little Otter Creek between the reservoir outlet and the confluence with Otter Creek.

5.5.5 Groundwater

Any registered or unregistered wells to be acquired within the right-of-way would be properly decommissioned. A licensed water well contractor would decommission the groundwater well(s) as specified under NRCS Missouri Construction Specification Code 351, Water Well Decommissioning (NRCS 2012). Proper decommissioning of affected wells would not have a significant impact on groundwater quality.

5.5.6 Wetlands

Wetlands permanently affected would require mitigation following prescribed replacement to affected ratios, (likely 1.5:1 or 2:1 replacement to affected ratio) requiring up to an estimated 8.2 acres of mitigation wetlands to be established. Appropriate mitigation sites would require adequate hydrology and the mitigation wetland areas should be seeded with a mix of hydrophytic grasses and sedges appropriate for the region to create in-kind replacement.

There would be no net loss of wetlands as a result of Proposed Action activities. Appropriate mitigation sites would require adequate soils and hydrology to establish wetland vegetation. Areas around new impoundments can provide suitable hydrology for the establishment of wetlands. The NRCS wetlands team would provide technical assistance in designing new wetlands.

Wetland mitigation sites and extent would be determined in coordination with USACE and MDNR. Wetland mitigation locations would focus on areas upstream and downstream of the Proposed Action. Locations downstream provide similar conditions to the affected wetlands. The lake itself would provide suitable hydrologic regimes for wetland mitigation sites in areas upstream of and along the shoreline of the Proposed Action.

Monitoring the progress of vegetation establishment and evaluating hydrology would be required annually for up to five years to ensure the success of the mitigation of wetland areas.

5.5.7 Water Quality

In order to provide proper erosion control before, during, and after construction of the Little Otter Creek Reservoir and dam, a phased approach of erosion and sediment controls would be implemented. Prior to any construction taking place, the following BMPs would need to be temporarily installed and maintained throughout the construction period in locations identified on the plan sheets and the SWPPP: The NPDES rules require a SWPPP on construction sites disturbing one or more acres. Potential BMPs would be needed at construction entrance(s), concrete washout areas, stockpile and staging areas, perimeter controls (sediment fence), sediment basins, sediment traps, diversion berms, diversion channels, steam crossings, and ditch checks.

During construction and mass grading, additional sediment fencing would be installed as needed. Erosion control blankets would be installed to provide permanent slope stabilization where indicated on the plans. Whenever activity has ceased for more than 14 days, disturbed areas would be temporarily seeded to provide protection to bare soils and reduce damage from sediment and runoff to downstream or off-site areas. The BMPs would be regularly inspected and maintained as indicated in the SWPPP throughout the life of the project to ensure proper erosion and sediment control protection is provided.

Once construction has completed, removal of the temporary BMPs would require excavated, disturbed areas be filled with suitable topsoil and any disturbed areas stabilized with either permanent seeding or erosion control blankets. Diversion channels are to remain in place until work in the downgradient area or natural channels are no longer required. When removed, the disturbed area shall be covered with topsoil and stabilized and seeded with mixes of appropriate native species.

In addition to protecting water quality, the BMPs include revegetation with native species to reduce the chance of invasive or non-native species being introduced to this area.

5.5.8 Terrestrial Wildlife

Project construction will comply with the MBTA and the BGEPA. Tree clearing would be done during the non-nesting season. If eagle nests are found prior to construction, they will be avoided, if possible, or a permit will be obtained to take a vacant nest. No active nests would be affected.

Most terrestrial wildlife would be able to move away from the areas of construction, which mostly would be focused on the dam area. However, a contingency plan would be developed prior to construction that would include a discussion of avoiding impacts to wildlife, rare species that are protected, and contacting agencies if any wildlife are found to be in distress.

5.5.9 Threatened and Endangered Species

Indiana and Northern Long-eared Bat

Although no Indiana or northern long-eared bats were found within the project area, ongoing coordination will be done with USFWS during design and construction phases. If any listed species are identified during construction, activities will cease immediately and appropriate agencies will be contacted.

Plains Spotted Skunk

Use of BMPs and, if necessary, coordination with the MDC is proposed to determine the presence or absence of the plains spotted skunk, and any potential conservation measures that may be required.

5.5.10 Transportation Impacts

Ongoing coordination with MoDOT and Caldwell County will be done throughout the project construction period. Information on detours and road closures will be provided to emergency service providers as well as local residents and businesses, and the general public.

5.5.11 Hazardous Materials

No potential water quality concerns or hazardous materials issues are expected to result from the Proposed Action. There would be no impacts to public health from implementation of the Proposed Action. If any unexpected contamination is found during construction, MDNR will be contacted.

5.5.12 Cultural Resources

If any areas of cultural or ancestral interest are found during construction, NRCS will contact their cultural resources specialist and the SHPO and initiate any necessary consultation prior to further construction.

5.5.13 Construction Temporary Impacts

See air quality mitigation section (Section 5.5.1) and water quality mitigation section (Section 5.5.7) for mitigation measures.

5.6 Relationship of Short-Term Uses and Long-Term Productivity

The Proposed Action will provide locally controlled agricultural water management (rural water supply); fish and wildlife habitat enhancement; recreational development; and flood damage reduction. The short-term uses are also long-term uses and benefit the community. The Proposed Action would improve the long-term productivity for the agricultural industry in the project area by creating a dependable water supply and by providing flood damage reduction. In addition, the Proposed Action would improve the long-term productivity for the recreation industry through the development of new recreation areas and opportunities.

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6.0 Compliance and Consultation with Applicable Laws, Policies, and Plans

Review and implementation of the Proposed Action requires coordination and compliance with multiple federal and state laws, regulations, EOs, and policies. The following have known applications to the Proposed Action.

Federal Laws, Regulations, and Policies

Bald and Golden Eagle Protection Act (BGEPA)

Bald and golden eagles have specific protection under the BGEPA;16 U.S.C. 668-668c., which is administered by the USFWS. Protections under this act prohibit "take" of bald and golden eagles.

Clean Water Act of 1972 (CWA)

The CWA is the principal law governing pollution control and water quality of waters of the United States. Section 402 of the act establishes a NPDES permitting program to regulate the point source discharge of pollutants into waters of the United States. Missouri administers state-level NPDES programs pursuant to the authority delegated by the EPA.

Section 404, with oversight from the EPA, authorizes the USACE to issue permits for the placement of dredged or fill materials into waters of the United States. USACE issues general permits on a state, regional, or nationwide basis for similar activities that cause minimal adverse environmental effects both individually and cumulatively. Individual permits may also be issued for specific activities on specific water bodies under Section 404.

An individual Missouri State Water Quality Certification (Section 401) would also be required.

Endangered Species Act

Federally listed threatened and endangered species are protected under the ESA of 1973 as amended (16 U.S.C. 1531 et seq.). Adverse effects on a federally listed species or its habitat would require consultation with the USFWS under Section 7 of the ESA. Section 7, as amended, requires federal agencies to ensure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of proposed, endangered, or threatened species or result in the destruction or adverse modification of their critical habitats.

Executive Order 11988 for Floodplain Management

EO 11988 requires federal agencies avoid, to the extent possible, the long- and short-term adverse impacts associated with the occupancy and modification of flood plains and avoid direct and indirect support of floodplain development wherever there is a practicable alternative. Through this, the EO strives to reduce the risk of flood loss, minimize the impact of floods on human safety, health, and welfare, and restore and preserve the natural and beneficial values served by flood plains for the following actions:

- Acquiring, managing, and disposing of federal lands and facilities;
- Providing federally undertaken, financed, or assisted construction and improvements;
- Conducting federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulation, and licensing activities.

Executive Order 11990 for Protection of Wetlands

The purpose of EO 11990 is to, "minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands." To meet these objectives, the EO requires federal agencies to consider alternatives to wetland sites and limit potential damage if an activity affecting a wetland cannot be avoided. The EO applies to acquisition, management, and disposition of federal lands and facilities construction, and improvement projects which are undertaken, financed, or assisted by federal agencies, as well as to federal activities and programs affecting land use. This includes, but is not limited to, water and related land resources planning, regulation, and licensing activities.

Executive Order 12898 for Environmental Justice

The president signed EO 12898, *Federal Actions to Address Environmental Justice in Minority and Low-Income Population*, in 1994. This EO is to focus the attention of federal agencies on human health and environmental conditions in minority communities and low-income communities. Environmental justice analyses are performed to identify the potential for disproportionately high and adverse impacts on minority and low-income populations from proposed actions, and to identify alternatives that might mitigate these impacts. This SEIS includes an environmental justice analysis for Caldwell County.

Executive Order 12962 for Recreational Fisheries

EO 12962, which was implemented in 1995, mandates that federal agencies, to the extent permitted by law and where practicable, improve the quality, function, and sustainable productivity and distribution of U.S. aquatic resources for increased recreational fishing opportunities. Activities to accomplish this may include developing and encouraging partnerships between governments and the private sector to advance aquatic resource conservation and enhance recreational fishing opportunities; identifying recreational fishing opportunities that are limited by water quality and habitat degradation and promoting restoration to support viable, healthy, and, where feasible, self-sustaining recreational fisheries; fostering sound aquatic conservation and restoration endeavors to benefit recreational fisheries; supporting outreach programs designed to stimulate angler participation in the conservation and restoration of aquatic systems; and implementing laws under the federal agency's purview in a manner that will conserve, restore, and enhance aquatic systems that support recreational fisheries.

In addition, this order establishes the National Recreational Fisheries Coordination Council, which oversees the actions of federal agencies to ensure they accomplish the goals outlined in the EO.

Executive Order 13112 for Invasive Species

In 1999, an EO was issued to prevent the introduction of invasive species and to provide for their control. It directs federal agencies to identify applicable actions and to use programs and authorities to minimize the economic, ecological, and human health impacts caused by invasive species. To meet the intent of this order, the Proposed Action includes environmental commitments to prevent and control the spread of invasive species.

Farmland Protection Policy Act of 1995

The purpose of the FPPA is to ensure that impacts to prime or unique farmlands are considered in federal projects. It requires federal agencies to consider alternative actions that could lessen

impacts and to ensure that their actions are compatible with state, local government, and private programs to protect prime and unique farmland. The NRCS is responsible for administering this act. Farmlands were considered in the Proposed Action analysis using the key indicators of changes in farm acreage and production. Prime and unique farmlands would be protected to the extent possible during implementation of the Proposed Action consistent with the act.

Fish and Wildlife Coordination Act

Public Law 83-566 projects are local projects installed with Federal assistance; not Federal projects, and are exempt from the provisions of the Fish and Wildlife Coordination Act (FWCA). However, Public Law 85-624, which contained the 1958 amendments to the FWCA, also added section 12 to Public Law 83-566. Section 12 (16 U.S.C. Section 1008) applies the principles of the FWCA to the Public Law 83-566 program. The NRCS State Conservationist must notify the U.S. Fish and Wildlife Service (USFWS) in order that it may provide recommendations for fish and wildlife resources, in accordance with the provisions of Public Law 83-566 Section 12.

Hazardous Materials Acts

The USEPA and other federal and state agencies regulate hazardous materials under the Toxic Substances Control Act; Comprehensive Environmental Response Compensation and Liability Act; RCRA; Superfund Amendments and Reauthorization Act; and Emergency Planning and Community Right-to-Know Act. RCRA gives the USEPA the authority to control hazardous waste from the “cradle-to-grave.” This includes the generation, transportation, treatment, storage, and disposal of hazardous waste. RCRA also sets forth a framework for the management of nonhazardous solid wastes. The 1986 amendments to RCRA enabled the USEPA to address environmental problems that could result from underground storage tanks containing petroleum and other hazardous substances.

Migratory Bird Treaty Act

Under the MBTA (16 U.S.C. 703-712: Ch. 128 *as* amended), construction activities in grassland, wetland, stream, and woodland habitats, and those that occur on bridges (for example, affecting swallow nests on bridge girders) that would otherwise result in the taking of migratory birds, eggs, young, and/or active nests should be avoided. Although the provisions of MBTA are applicable year-round, most migratory bird nesting activity in Missouri occurs during the period of April 1 to July 15. However, some migratory birds are known to nest outside the aforementioned primary nesting season. For example, raptors (such as hawks, falcons, and owls) can be expected to nest in woodland habitats during February 1 through July 15, whereas sedge wrens, which occur in some wetland habitats, normally nest from July 15 to September.

Missouri Clean Water Commission, Water Quality Standards, 10 CSR 20-7

Water quality in Missouri is regulated by classifying water bodies according to designated beneficial uses and then assigning specific numerical water quality criteria that must be maintained to protect the assigned beneficial uses. Water bodies that are not classified, fall under the General Criteria (10 CSR 20-7.031[3]) for all waters of the state.

National Historic Preservation Act of 1966

The NHPA establishes protection of historic properties as federal policy in cooperation with states, tribes, local governments, and the public. Historic properties are those buildings, structures, sites,

objects, and districts, or properties of traditional religious and cultural importance to Native Americans, determined to be eligible for inclusion in the NRHP. Section 106 of the act requires federal agencies to consider the effect of proposed actions on historic properties and gives the Advisory Council on Historic Preservation an opportunity to comment. The lead federal agency is responsible for consultation with the State Historic Preservation Officer and/or Tribal Historic Preservation Offices, tribes, applicants, interested parties, and local governments regarding federal undertakings. When previously unidentified cultural resources are encountered, the project includes environmental commitments to comply with the act.

National Invasive Species Act of 1996

The purpose of the National Invasive Species Act of 1996 is to: 1) prevent unintentional introduction and dispersal of nonindigenous species in the waters of the United States through ballast water management and other requirements; 2) to coordinate federally funded or authorized research, prevention control, information dissemination, and other activities regarding the zebra mussel and other aquatic nuisance species; 3) to develop and carry out environmentally sound control methods to prevent, monitor, and control unintentional introductions of nonindigenous species from pathways other than ballast water exchange; 4) to understand and minimize economic and ecological impacts of nonindigenous aquatic nuisance species that become established, including zebra mussel; and 5) to establish a program of research and technology development and assistance to states in the management and removal of zebra mussels (i.e., Aquatic Nuisance Species Task Force 1996). To comply with the act, the Proposed Action incorporates design features to minimize invasion of nonindigenous species and monitor the distribution network for effective prevention of their spread.

Native American Graves Protection and Repatriation Act of 1990

This act, “describes the rights of Native American lineal descendants, Indian tribes, and Native Hawaiian organizations with respect to the treatment, repatriation, and disposition of Native American human remains, funerary objects, sacred objects, and objects of cultural patrimony, referred to collectively in the statute as cultural items, with which they can show a relationship of lineal descent or cultural affiliation.”

Safe Drinking Water Act of 1974

This act gave the USEPA the authority to set standards for drinking water quality in water delivered by public water suppliers. Analysis of water quality in the SEIS indicates that there would be minor to no measurable changes from the existing conditions for the Proposed Action.

The Uniform Relocation Act of 1970

The Uniform Relocation Act is a federal law that, “establishes minimum standards for federally funded programs and projects that require the acquisition of real property or displace persons from their homes, businesses, or farms. The Uniform Relocation Act’s protections and assistance apply to the acquisition, rehabilitation, or demolition of real property for federal or federally funded projects.” (U.S. Department of Housing and Urban Development [HUD] 2016).

Watershed Protection and Flood Prevention Act of 1954

This act, also known as PL 83-566, is a law that protects watersheds from erosion, sedimentation, and flooding. Under this act, technical and financial assistance is provided to state and local

government through the NRCS to prevent erosion, floodwater, and sediment damage; to further the conservation, development, use, and disposal of water; and to further the conservation and proper use of land in authorized watersheds.

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7.1 Agency Coordination

The interagency review team provided information on its special expertise or jurisdiction related to the Proposed Action, assisted with analyses, and reviewed SEIS sections. The following organizations participated:

- Caldwell County
- USDA, NRCS
- USACE
- USEPA
- MDNR
- MDC
- USFWS

As part of the interagency review team, staff or representatives from the above organizations were provided opportunities to review and comment on specific portions of the text. Seventeen meetings have been held in person or via conference call some or all the members of the interagency review team to review content and provide comments. These meetings occurred on the following dates:

December 6, 2012
January 17, 2013
February 21, 2013
April 24, 2013
January 27, 2014
March 19, 2014
May 15, 2014
July 17, 2014
October 15, 2014
December 4, 2014
February 5, 2015
May 20, 2015
July 28, 2015
January 21, 2016
June 28, 2016
October 26, 2016
January 10, 2017

In addition, written comments were received from the interagency review team on two additional submittals where a meeting to discuss comments was not held. Comments on these submittals were received:

November 24, 2015
June 30, 2017

In parallel with the SEIS formulation, NRCS has been coordinating an interagency Ecological Flows Task Force to develop a Water Management Plan to minimize the impact of the Proposed Action on downstream ecological functions. The Ecological Flows Task Force includes representatives from:

- Caldwell County
- USDA, NRCS
- MDC
- MDNR

The Ecological Flows Task Force held meetings on the following dates:

January 14, 2013
February 14, 2013
August 22, 2013
October 3, 2013
November 6, 2013
December 5, 2013
January 22, 2014
April 8, 2014
Ma 7, 2014
June 18, 2014
September 22, 2014
January 6, 2015
March 4, 2015
May 12, 2015
March 8, 2016
April 21, 2016
May 31, 2016
July 1, 2016
August 16, 2016
October 27, 2017

The Project Sponsor, Caldwell County, has hosted project update meetings for agencies, state and federal congressional staffs, and members of the public periodically throughout the project. At these meetings, the progress of the SEIS, efforts related to the SEIS, funding, and other project considerations were discussed. These meetings occurred:

November 27, 2012
February 19, 2013
April 19, 2013
June 28, 2013
February 21, 2014
September 26, 2014
July 9, 2015
October 23, 2015
January 22, 2016
March 25, 2016
April 22, 2016
May 20, 2016
July 15, 2016
September 16, 2016
November 18, 2016
January 20, 2017
March 17, 2017
May 19, 2017
July 21, 2017
August 25, 2017
September 8, 2017

7.2 Comments on the Notice of Intent

Page 5 of the notice of intent states that “the NRCS invites full public participation to promote open communication and better decision-making. All persons and organizations with an interest in the [project] are urged to comment. Public comments are welcomed and opportunities for public participation include submitting comments to NRCS: 1) during the development of the SEIS, 2) during the review and comment period upon publishing the SEIS; and 3) for 30 days after publication of the Final SEIS. Distribution of the comments received will be included in the Administrative Record without change and may include any personal information provided, unless the commenter indicates that the comment includes information claimed to be confidential business information.”

Only one comment was received on the notice of intent.

7.3 Public Review and Comments on the SEIS

The SEIS is estimated to be available for public review in 2019.

7.4 Intended Uses of the SEIS

The purpose of the SEIS is to address changes that have occurred since the NRCS prepared the Little Otter Creek Watershed Plan and Environmental Impact Statement (NRCS 2003).

7.5 Document Recipients

See Section 9 – Distribution List

7.6 Elected Officials and Representatives

Senator Roy Blunt
260 Russell Senate Office Building
Washington, D.C. 20510

Senator Josh Hawley
B40A Dirksen Senate Office Building
Washington, D.C. 20510

Congressman Sam Graves, Sixth Congressional District
1415 Longworth HOB
Washington, D.C. 20515

Representative James W. Neely, Missouri House of Representatives
201 W. Capitol Avenue, Room 110-A
Jefferson City, MO 65101

Senator Denny Hoskins, Missouri State Senate
201 W. Capitol Avenue, Room 227
Jefferson City, MO 65101

7.7 Government Departments and Agencies

The following government departments and agencies have an involvement or interest in this SEIS:

- Caldwell County
- MDC
- MDNR
- USDA, NRCS
- USACE
- USEPA
- USFWS

1.0 Introduction and Purpose and Need

2.0 Alternatives Analysis

3.0 Affected Environment and Predicted Environmental Consequences

4.0 Cumulative and Growth-Inducing Effects

5.0 Comparison of Alternatives and Mitigation

6.0 Compliance and Consultation with Applicable Laws, Policies, and Plans

7.0 Public Involvement

8.0 List of Preparers

9.0 Distribution List

10.0 Reference

8.0 List of Preparers

A list of the organizations and persons who prepared various sections of this SEIS are listed below:

Natural Resources Conservation Service

Clifford Baumer, PE, Environmental Engineer
Harold Deckerd, PE, Assistant State Conservationist - Water Resources (Retired)
Chris Hamilton, Assistant State Conservationist - Water Resources
Steve Hefner, Natural Resources Specialist

Olsson Associates

Chad Johnson, PE, Technical Leader
Aaron Ball, Senior Scientist
Joan Darling, PhD, Technical Leader
Kari Cantarero, Associate Scientist
Nan Elzinga, Senior Engineer
Ed Hubert, Environmental Group Leader
Hilary Clark, Senior Scientist

Allstate Consultants LLC

John Holmes, PE, Senior Engineer
Aaron Jones, PE, Senior Engineer
Cary Sayre, PE, Senior Engineer
Greg Pitchford, Senior Scientist

1.0 Introduction and Purpose and Need

2.0 Alternatives Analysis

3.0 Affected Environment and Predicted Environmental Consequences

4.0 Cumulative and Growth-Inducing Effects

5.0 Comparison of Alternatives and Mitigation

6.0 Compliance and Consultation with Applicable Laws, Policies, and Plans

7.0 Public Involvement

8.0 List of Preparers

9.0 Distribution List

10.0 Reference

9.0 Distribution List (Abridged)

9.1 Federal Agencies

- U.S. Army Corps of Engineers, Kansas City District
- Environmental Protection Agency, Region 7
- United States Fish and Wildlife Service

9.2 State Agencies

- Missouri Department of Natural Resources
- Missouri Department of Conservation
- Missouri Department of Agriculture
- Missouri Department of Transportation
- Missouri Department of Economic Development

9.3 Local Agencies

- Caldwell County Commission
- Caldwell County Soil and Water Conservation District
- Little Otter Creek Wholesale Water Commission
- Green Hills Regional Planning Commission

9.4 Elected Officials

- U.S. Senator Roy Blunt
- U.S. Senator Josh Hawley
- U.S. Congressman Sam Graves
- Governor Mike Parson
- State Senator Denny Hoskins
- State Representative Jim Neely

10.0 Reference

10.0 References

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Appendix A

Supporting Documentation

Letter from Representative Sam Graves to Governor Eric Greitens

SAM GRAVES
6th District, Missouri

1135 Longworth House Office Building
Washington, DC 20515
(202) 225-7041

11724 NW Plaza Circle, Suite 900
Kansas City, MO 64153
(816) 792-3976

411 Jules Street, Room 111
St. Joseph, MO 64501
(816) 749-0990

906 Broadway, P.O. Box 364
Hannibal, MO 63401
(573) 221-3400

Congress of the United States
House of Representatives
Washington, DC 20515-2506

April 4, 2017

Governor Eric Greitens
P.O. Box 720
Jefferson City, MO 65102-0720

Dear Governor:

As the State of Missouri continues through the budget and appropriation process in the state legislature, I would like to reaffirm my support for the Little Otter Creek Watershed Reservoir project in Caldwell County.

Caldwell County is in a part of north Missouri where water security is a major issue. Indeed, in 2012, the city lake of Hamilton was within a few weeks of running out of water for the city. Recognizing this need, my office joined with the County more than 15 years ago to start the process and help fund a reservoir project on Little Otter Creek. In addition to providing the necessary water security for the region, this project will alleviate the flash flooding that has occurred on the creek while also providing recreational options for the community.

Caldwell County passed a local ½-cent sales tax with an overwhelming majority to help support the project and, with the assistance of my Senate colleagues, Congress has been able to provide nearly $11 million in federal funding for the project. This project cannot receive any more federal funding, as more federal funding would only require a larger local share, which is what project stakeholders are asking for the State's assistance with at this time. The project is in need of $4.6 million in funding from the State of Missouri to meet this local match. $2 million was appropriated by the state legislature in 2016, but later withheld by then-Governor Nixon.

This summer, the project engineers anticipate receiving the necessary permitting from the United States Army Corps of Engineers and the Missouri Department of Natural Resources and will be in position to begin construction in late 2017 or early 2018 with construction of the dam and reservoir being completed in 2018. This project is estimated by DNR to create 96 jobs with an annual economic impact of $2.5 million over the first six years.

The Little Otter Creek Watershed Reservoir project has my full support and I believe it is well suited for this funding and worthy of your full and fair consideration. If you have any questions about the project, please do not hesitate to contact Josh Hurlbert in my Kansas City District office at Josh.Hurlbert@mail.house.gov or at 816-792-3976.

Sincerely,

Sam Graves
Member of Congress

Letter from Chillicothe Municipal Utilities to Caldwell County

CHILLICOTHE MUNICIPAL UTILITIES
ELECTRIC, WATER, REFUSE, SANITARY SEWER
920 WASHINGTON ST., PO. BOX 140
CHILLICOTHE, MISSOURI 64601
TELEPHONE 660-646-1664 - Customer Info. 660-646-1683 - Administrative
Fax 660-646-4181 EMAIL info@cmuchillicothe.com

September 5, 2018

Caldwell County Commissioners,

Please allow this letter to serve as the answer to whether Chillicothe Municipal Utilities can provide a firm water supply to Caldwell County. Although CMU has excess capacity at the time, we are not willing to sell on a firm basis. CMU has over the years prepared themselves for growth and economic development. The City is very active in pursuing economic development projects and many of those companies are heavy water consumers, including food manufacturers. We also sell to present customers and won't put their service in jeopardy either. As you can see, CMU would not be able to offer Caldwell County any type of permanent or a firm sale of water contract.

We appreciate you contacting us, but at this time CMU cannot commit to the type of service that you need and desire. We wish you the best of luck in solving your water needs and hope you get it worked out.

Feel free to call if you have any questions.

Sincerely,

Jim Gillilan
General Manager

Your Community Owned Utility

Letter from Missouri Department of Natural Resources to Caldwell County Regarding Groundwater Possibilities in Caldwell County

STATE OF MISSOURI

Jeremiah W. (Jay) Nixon, Governor • Sara Parker Pauley, Director

DEPARTMENT OF NATURAL RESOURCES

www.dnr.mo.gov

December 6, 2012

Caldwell County Commission
C.R. Bud Motzinger – Presiding Commissioner
49 E. Main
P.O. Box 67
Kingston, MO 64650

RE: Groundwater possibilities in Caldwell County

Dear Mr. Motzinger:

Much of northern Missouri is covered by glacial drift. This material consists of clay, silt, sand, gravel and even boulders that were deposited by glaciers on top of older bedrock. The glacial drift varies from a few feet thick to more than 200 feet thick in some locations. In many places, the glacial drift contains no layers of clean sand and gravel. Clean sand is sand that contains little or no clay or silt. For a successful low capacity well (for domestic or livestock use) to be constructed, generally 100 feet of glacial drift containing at least a few feet of clean sand or gravel is needed. Drilling records indicate glacial drift may not be present in parts of Caldwell County and may be over 150 feet thick in other parts. Well records also indicate the lack of clean sand or gravel within the drift where it is present.

Deposits of Pennsylvanian age limestone, sandstone and shale underlie the glacial drift. These deposits contain some water, but the quality is typically so poor that the water is not suitable for use. Water in these deeper bedrock aquifers in high is sulfate, chloride and total dissolved solids making it too highly mineralized for use.

High capacity wells (for public water supply use) in Caldwell County are limited to production from alluvial deposits. These deposits are found in alluvium filled valleys of current streams or ancient alluvial valleys that have been covered by glacial drift. The ability of alluvium to transmit water is generally very high. However, production depends on local characteristics of the alluvium as well as diameter of the well and proper construction techniques. For these types of wells to be productive, the sediments should be clean and free of fine grained particles (silt or clay). Desirable sediments are coarse sands, gravels, cobbles and boulders. These sediments often occur very sporadically when present and may alternate with clay, silt or other undesirable sediments. They normally occur as long, narrow, sinuous deposits located parallel to the river or valley.

Total depth for these wells depends on the depth of the alluvium filled valley. Existing public water supply wells in Caldwell County range from 45 to 62 feet in total depth with casing depths of 10 to 54 feet. Both total depth and casing depth are controlled by the geologic, geomorphic and hydrologic circumstances at the specific well site. Maximum reported yield for a few of these public wells is 150

gallons per minute (gpm). However, yields of less than 50 gpm are much more common in these public water supply system wells.

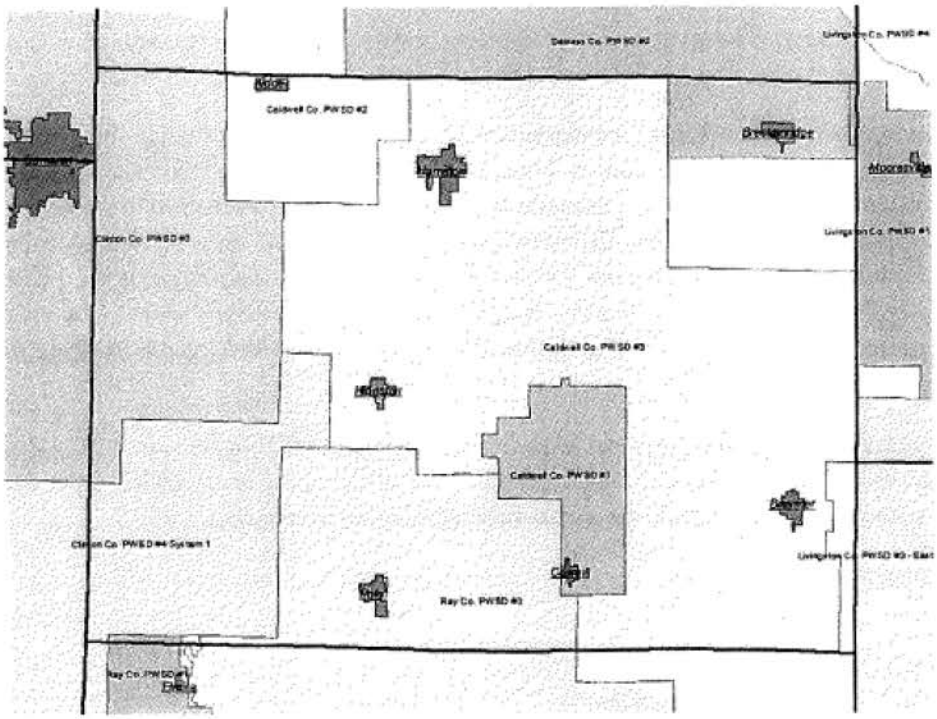
Based on the highly variable nature of the deposition of clean sediments and the amount of production that may be obtained from them, one cannot estimate the likelihood of being able to produce 1.24 million gallons per day (mgd) county wide. An example of the variability can be seen within a couple of communities in the county. Polo currently has two active alluvial public wells. The total depths are 58 and 59 feet with yields of 75 and 150 gpm. Drilling records indicate at least 10 test holes were drilled before completing these two wells. Similarly, Braymer has three active public wells in Caldwell Co, with two additional in Livingston Co, but had to drill at least 11 test wells before completing these five. Each of these wells produce only 25 gpm.

Another issue with groundwater usage can be seen just to the north in Daviess County. The communities of Coffey and Jameson have ceased using groundwater due to increasing demands and the lowering of the water level within the alluvial aquifer which has resulted in reduced capacity.

Below is a summary of public water sources in Caldwell Co and a map of the water districts in the county.

- Braymer-groundwater
- Breckenridge-surface water
- Caldwell Co PWSD #1-groundwater
- Caldwell Co PWSD #2-surface water
- Caldwell Co PWSD #3-surface water
- Clinton Co PWSD #3-surface water
- Clinton Co PWSD #4-surface water
- Daviess Co PWSD #2-2/3 groundwater, 1/3 surface water
- Hamilton-surface water
- Kingston-groundwater
- Polo-groundwater
- Ray Co PWSD #3-groundwater

Mr. Motzinger
December 6, 2012
Page 3



There currently are a limited number of wells in Caldwell County producing water for a public water supply system. In addition these wells have very modest yields. Because of this the cities of Hamilton and Breckenridge plus Caldwell County PWSD #2 and #3 collect surface water for distribution. Furthermore, many of the residents of the county obtain their water from sources outside of the county (water supply districts from Clinton, Daviess and Ray counties). These facts indicate a very high likelihood that increased groundwater production is not a viable option to supply the estimated 1.24 mgd that will be needed in the future for Caldwell County.

Should you have any questions, feel free to contact me by mail at P.O. Box 250, Rolla, MO 65402; by phone at 573-368-2194; by fax at 573-368-2193; or by email at scott.kaden@dnr.mo.gov.

Sincerely,

DEPARTMENT OF NATURAL RESOURCES

Scott Kaden, R.G.
Groundwater Section Chief
Water Resources Center

December 6, 2012
Page 3 of 3

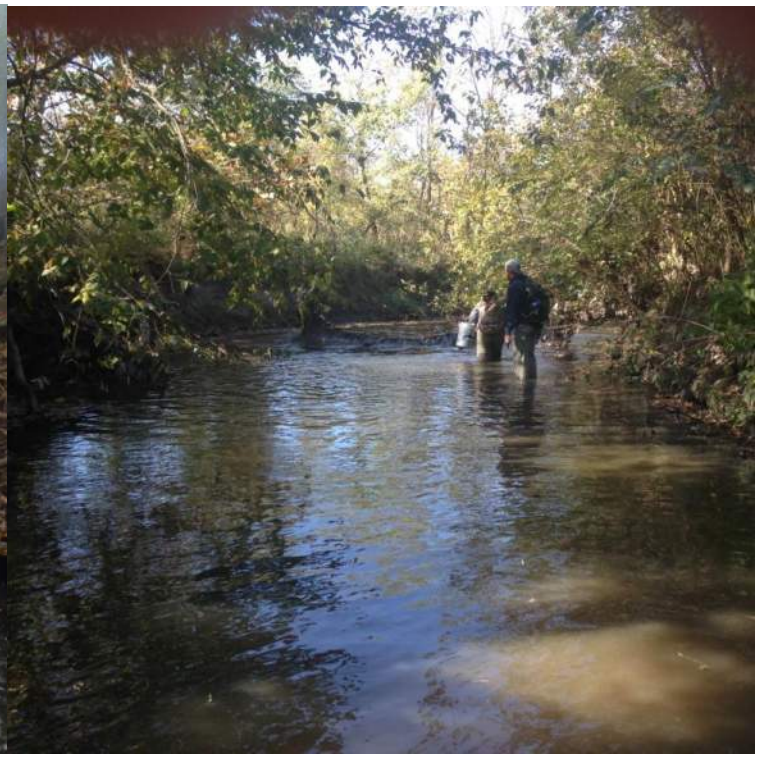
c: Mr. John Holmes, Allstate Consultants

Topeka Shiner Study

Little Otter Creek Topeka Shiner Survey

December 2015

Final Report

Contracting Company:
Olsson Associates
Overland Park, Kansas

Prepared by:
Daniel Beckman (Principal Investigator)
Bryce Maynard (Research Aide)

Department of Biology
Missouri State University
Springfield, Missouri

Little Otter Creek Topeka Shiner Survey

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Project Site: Little Otter Creek, Caldwell County, Missouri

Project Summary

The goal of this study was to perform a presence/absence survey for the Topeka shiner (*Notropis topeka*) in Little Otter Creek and tributaries in Caldwell County southeast of Hamilton, Missouri, as indicated in Figure 1. Pool sites were surveyed within and two miles upstream of the normal flood pool, and 2.5 miles downstream of the proposed dam location. Sampling was carried out until all pools were sampled. At each site, the pool was sampled using a 20-foot bag seine with one-eighth-inch mesh netting. All fish collected during sampling were identified onsite and released. Voucher specimens were retained and photos taken for representatives of all shiner species collected. Sampling was carried out in a total of 160 pools. A total of 17 fish species were collected, including four species of shiners of the genera *Notropis*, *Cyprinella*, and *Lythrurus*; no Topeka shiners were collected within the sample reach.

Background

The Topeka shiner was historically abundant in headwater streams throughout much of the Central Prairie Region of the United States. This included portions of Iowa, Kansas, Minnesota, Missouri, Nebraska, and South Dakota (USFWS 1993). Currently, it is found only in isolated populations in a few tributaries to the Missouri and Mississippi rivers and in the Flint Hills region of Kansas. Declines have been attributed to various factors, including habitat modification resulting from siltation, nutrient input, impoundment, and reduced water levels caused by agriculture, urbanization, and highway construction (Cross and Moss 1987; Minckley and Cross 1959; Pflieger 1997; USFWS 2005). Predation and competition with other fishes, including stocked largemouth bass and sunfishes, has likely affected Topeka shiners (Winston 2002). The Topeka shiner has been extirpated from many of the tributaries in its historic range in Missouri (Pflieger 1997) and now occurs only in disjunct populations in the Missouri River basin (MDC 2010). Sampling carried out by the Missouri Department of Conservation at historic sites in the 1990s identified approximately 15 separate populations, most of which were smaller than historically documented (Gelwicks and Bruenderman 1996). Topeka shiners have not been documented in Little Otter Creek, the location of the proposed study; however, prior to 1975, but not since, a population was documented in Shoal Creek, of which Little Otter Creek is a tributary (MDC 2010). This project was designed to determine whether Topeka shiners are present within an area of its historic range, for which they have not previously been documented to occur.

Methodology

The sampling reach extends from 2.57 miles south of the proposed dam location to the headwaters of Little Otter Creek near Hamilton, Missouri. The proposed reservoir and associated unnamed tributaries to Little Otter Creek are included in the sampling area, which also includes the headwaters of Little Otter Creek and a reach from the proposed dam location to 2.57 miles downstream.

The sampling reach includes Little Otter Creek in Caldwell County, Missouri; southeast of Hamilton, Missouri; between Highway 36 and the confluence of Little Otter Creek with Otter Creek. The area is included in the following public land survey system sections: Sections 16, 17, 19, 20, 21, 28, 29, 32, and 33; Township 57 North; Range 27 West; and Sections 4 and 9; Township 56 North; Range 27 West.

Sampling was carried out under the U.S. Fish and Wildlife Service's Native Endangered Species Recovery Permit TE64082B-0. To help minimize stress and potential fish mortality, the sampling period was in the fall before most leaf fall had occurred and after water temperatures had dropped. Sampling was carried out from October 17 through October 28, 2015, by a crew of four to five individuals until all pools were sampled. Dates of sampling included October 17, 18, 24, 25, and 28.

Pool identifiers (GPS coordinates) were assigned to each pool within the sample reach using a handheld Trimble Geo 7X GPS unit. All pools within the sampling reach were sampled. Riffles and runs were excluded, since they are not considered appropriate habitat for Topeka shiners. Each pool was sampled with a 20-foot (ft) × 6-ft (4.57-meter [m] x 1.83-m), one-eighth-inch (0.32-centimeter [cm]) mesh bag seine to collect fish. To be more effective in narrow pools (width of less than 6 feet), the net was shortened, or a non-bag seine was used.

For shiners, including genera *Cyprinella*, *Lythrurus*, *Luxilus*, and *Notropis*, up to four voucher specimens were taken, and photographs were made of representatives of each species collected. For all other fish collected, time out of the water was minimized by returning individuals to the water immediately after identification. Persons involved in the sampling process were taught proper sampling and handling techniques to reduce the possibility of injury and/or death to any Topeka shiners collected. Voucher specimens were preserved in 70-percent ethanol and retained at Missouri State University.

Results

Sampling was carried out in 160 separate pools in Little Otter Creek and tributaries (Figure 1). GPS coordinates for each pool location are given in Appendix A. A total of 17 species were collected (Table 1). There was no evidence of Topeka shiners within the range of our survey; no Topeka shiner specimens were taken in any of the samples. Species most commonly encountered were centrarchid (bass and sunfish) species, bluegill, spotted bass, and green sunfish; and cyprinid (minnows) species, creek chub, central stoneroller, and bluntnose minnow. Shiners collected include the sand shiner, bigmouth shiner, red shiner, and redfin shiner (Table 2, Figure 2), found in 20, 3, 21, and 14 pools, respectively (Table 1). Each of these shiners is considered common within stream drainages that include Little Otter Creek (Pflieger 1997). Although this study was not designed to determine reasons for the absence of Topeka shiners at this location, possibilities include habitat modification due to agricultural activities and highway construction (USFWS 2005) and predation by or competition with spotted bass and sunfish (Winston 2002).

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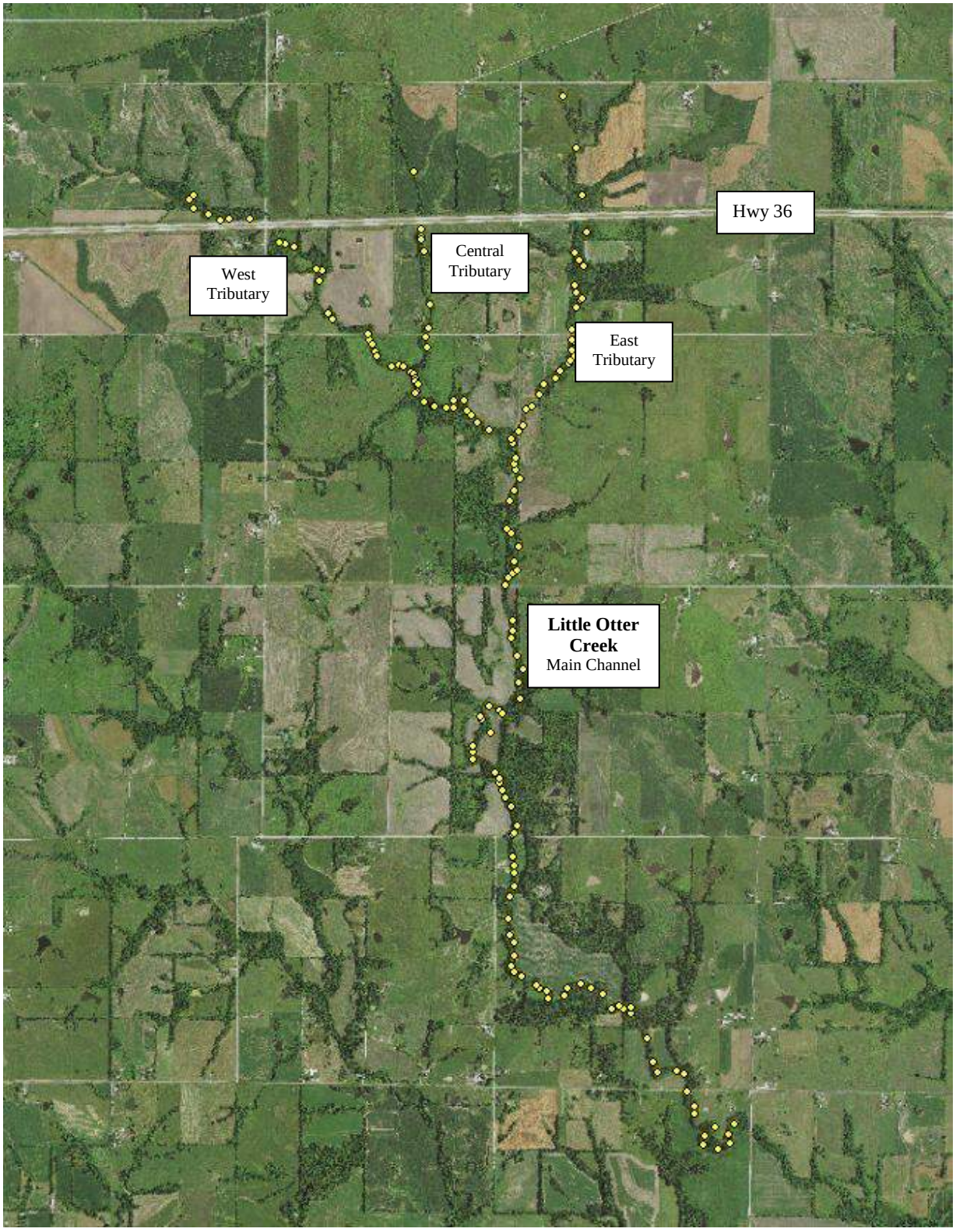

Figure 1. Map of Little Otter Creek and tributaries in Caldwell Country, Missouri. Pools are indicated by yellow dots. Fish sampling was carried out in each pool. See Appendix A for GPS coordinates for each pool.

Figure 2. Photos of voucher specimens of shiner species collected in Little Otter Creek and tributaries.

Table 1. Fish species collected in Little Otter Creek and tributaries. Numbers indicate the total number of pools where each species was collected.

SPECIES	Number of pools
Minnows/Shiners (Cyprinidae)	
Sand Shiner (*Notropis ludibindus*)	20
Bigmouth Shiner (*Notropis dorsalis*)	3
Red Shiner (*Cyprinella lutrensis*)	21
Redfin Shiner (*Lythrurus fumeus*)	14
Bluntnose Minnow (*Pimephales notatus*)	33
Fathead Minnow (*Pimephales promelas*)	2
Central Stoneroller (*Campostoma anomalum*)	52
Creek Chub (*Semotilus atromaculatus*)	65
Suckers (Catostomidae)	
White Sucker (*Catostomus commersoni*)	11
Catfishes (Ictaluridae)	
Black Bullhead (*Ameiurus melas*)	5
Yellow Bullhead (*Ameiurus natalis*)	1
Basses/Sunfishes (Centrarchidae)	
Largemouth Bass (*Micropterus salmoides*)	12
Spotted Bass (*Micropterus punctulatus*)	39
Bluegill (*Lepomis macrochirus*)	67
Green Sunfish (*Lepomis cyanellus*)	35
Black Crappie (*Pomoxis nigromaculatus*)	1
Darters (Percidae)	
Johnny Darter (*Etheostona nigrum*)	7

Table 2. GPS locations of pools where shiners (cyprinid minnows of the genera *Notropis*, *Cyprinella*, and *Lythrurus*) were collected in Little Otter Creek and tributaries. 'X' indicates pools in which the indicated species were collected.

Pool ID Number	456	304	315	410	402	231	228	225	219	210	209	208	207	205	201	121	115	110	109	108	107	105	104	102	100b	50	49	48	44	40	39	37	34	31	30	29	28	27	26	24	23	22	20	8	7	6	4	2
Latitude	417,562	418,186	418,451	418,404	419,287	419,368	419,353	419,358	419,129	418,978	419,005	418,974	418,943	419,004	418,935	418,951	418,881	418,712	418,703	418,709	418,851	418,876	418,897	418,950	418,976	418,964	418,970	418,970	418,942	418,969	419,018	419,136	419,297	419,463	419,543	419,599	419,647	419,671	419,718	419,825	419,862	419,889	420,061	420,124	420,253	420,192	420,278	420,340
Longitude	4,398,590	4,397,830	4,397,570	4,398,020	4,399,550	4,398,200	4,397,980	4,397,890	4,397,650	4,397,170	4,397,110	4,397,030	4,396,970	4,396,670	4,396,470	4,396,090	4,395,630	4,395,400	4,395,360	4,395,310	4,395,230	4,395,160	4,395,120	4,395,010	4,394,840	4,394,690	4,394,630	4,394,580	4,394,190	4,393,950	4,393,930	4,393,850	4,393,800	4,393,850	4,393,810	4,393,720	4,393,740	4,393,710	4,393,730	4,393,520	4,393,380	4,393,310	4,393,300	4,393,040	4,392,960	4,392,910	4,392,820	4,392,910
SPECIES																																																
Sand Shiner									x				x	x	x						x		X		x		x	x					x	x	x	x	x	x		x	x	x	x				x	
Bigmouth Shiner													x										X																									x	
Red Shiner			x								x	x					x	x	x	x	x	x	X	x		x		x	x	x	x	x	x	x					x	x		x			x	x	x	x
Redfin Shiner	x	x		x	x	x	x	x		x		x				x				x																								x				

Appendix A. Fish presence/absence data and GPS location for each pool in the sample reach. 'X' indicates collection of the species at the indicated location. Pools are listed in an upstream to downstream order within each tributary. The western tributary is between NE Spring Hill Road and its confluence with the eastern tributary near NE Ponderosa Road. The center tributary is between NE Old 36 Hwy and its confluence with the western tributary near NE Sandstone Drive. The eastern tributary is between NE Hicks Drive and its confluence with the western tributary near NE Ponderosa Road. (See Figure 1).

Western Tributary

Pool ID Number	332	331	330	329	328	327	326	458	457	456	455	454	453	452	451	450	300	301	302	303	304	305	306	308	309	310	311	307	312	313	314	315	316	317	318	319	320	321	322	323	324
Latitude	416,892	416,920	416,918	417,014	417,092	417,153	417,286	417,468	417,509	417,562	417,704	417,744	417,728	417,786	417,810	418,034	418,048	418,069	418,081	418,090	418,186	418,238	418,265	418,359	418,313	418,330	418,335	418,335	418,351	418,341	418,398	418,451	418,463	418,534	418,587	418,585	418,655	418,665	418,700	418,735	418,814
Longitude	4,398,890	4,398,920	4,398,830	4,398,800	4,398,770	4,398,770	4,398,770	4,398,620	4,398,610	4,398,590	4,398,450	4,398,440	4,398,380	4,398,160	4,398,130	4,398,040	4,398,000	4,397,960	4,397,920	4,397,900	4,397,830	4,397,840	4,397,830	4,397,710	4,397,790	4,397,780	4,397,750	4,397,740	4,397,660	4,397,660	4,397,600	4,397,570	4,397,570	4,397,560	4,397,570	4,397,610	4,397,610	4,397,550	4,397,520	4,397,460	4,397,420
SPECIES																																									
Sand Shiner																																									
Bigmouth Shiner																																									
Red Shiner																																X									
Redfin Shiner										X											X																					
Bluntnose Minnow																											X					X		X							
Fathead Minnow																																X									
Central Stoneroller										X								X	X					X		X	X	X					X	X		X				X	
Creek Chub	X	X						X		X								X	X	X	X		X	X		X			X	X		X	X	X						
White Sucker																																									
Black Bullhead																		X																								
Yellow Bullhead																																									
Largemouth Bass																					X																				
Spotted Bass																		X		X	X	X		X	X		X					X	X		X						
Bluegill		X						X		X		X	X					X	X	X	X	X			X		X		X	X	X	X			X		X				
Green Sunfish																		X		X	X				X							X						X			X
Black Crappie																																									
Johnny Darter																									X																
Species/Pool	1	2	0	0	0	0	0	2	0	4	0	1	1	0	0	0	0	6	3	4	6	2	1	3	4	2	4	1	2	2	1	7	3	3	2	1	1	3	0	1	1

Appendix A (con.)

	Center Tributary									Eastern Tributary																														
Pool ID Number	403	404	405	406	407	408	409	410	411	402	401	400	239	238	237	236	235	234	233	232	231	230	229	228	227	226	225	224	223	222	221	220	219	218	217	216	215		
Latitude	418,326	418,373	418,379	418,372	418,400	418,433	418,427	418,404	418,412	419,287	419,365	419,402	419,436	419,362	419,391	419,419	419,361	419,369	419,403	419,396	419,368	419,342	419,344	419,353	419,351	419,343	419,358	419,333	419,322	419,267	419,239	419,157	419,129	419,085	419,050	419,027	419,002		
Longitude	4,399,080	4,398,700	4,398,660	4,398,640	4,398,560	4,398,230	4,398,070	4,398,020	4,397,950	4,399,550	4,399,220	4,398,920	4,398,680	4,398,550	4,398,510	4,398,460	4,398,350	4,398,300	4,398,260	4,398,250	4,398,200	4,398,060	4,398,000	4,397,980	4,397,990	4,397,930	4,397,890	4,397,870	4,397,840	4,397,790	4,397,750	4,397,710	4,397,650	4,397,570	4,397,550	4,397,450	4,397,410			
SPECIES																																							
Sand Shiner																																	X						
Bigmouth Shiner																																							
Red Shiner																																							
Redfin Shiner								X		X											X			X			X													
BluntnoseMinn.																												X		X			X						
Fathead Minn.			X																																				
Stoneroller										X		X																				X	X	X	X	X				
Creek Chub							X			X		X																								X	X			
White Sucker																																							
Black Bullhead								X		X																														
Yellow Bullhead																																							
Largemouth																												X		X		X							
Spotted Bass						X		X		X					X				X									X		X			X						
Bluegill								X		X					X				X		X		X		X		X		X				X	X					
Green Sunfish			X	X				X		X		X			X													X		X									
Black Crappie																																							
Johnny Darter																																							
Species/Pool	0	0	2	1	0	1	1	5	0	7	0	3	0	0	3	0	0	0	2	0	2	0	1	1	1	0	2	4	1	4	0	2	5	2	1	2	1		

Appendix A (con.)

Little Otter Creek – Main Channel

Pool ID Number	214	213	212	211	210	209	208	207	206b	206a	205	204	203	202	201	200	123	122	121	120	119	118	117	116	115	114	113	112	111	110	109	108	107	106	105	104	103	102	101	100b	100a
Latitude	418,955	418,962	418,979	418,974	418,978	419,005	418,974	418,943	418,922	418,952	419,004	418,971	418,987	418,964	418,935	418,914	418,965	418,959	418,951	418,989	419,028	418,996	419,008	418,898	418,881	418,808	418,755	418,767	418,822	418,712	418,703	418,709	418,851	418,881	418,876	418,897	418,913	418,950	418,989	418,976	418,963
Longitude	4,397,360	4,397,330	4,397,240	4,397,200	4,397,170	4,397,110	4,397,030	4,396,970	4,396,790	4,396,760	4,396,670	4,396,580	4,396,520	4,396,500	4,396,470	4,396,430	4,396,200	4,396,130	4,396,090	4,395,970	4,395,890	4,395,810	4,395,700	4,395,600	4,395,630	4,395,650	4,395,590	4,395,570	4,395,490	4,395,400	4,395,360	4,395,310	4,395,230	4,395,190	4,395,160	4,395,120	4,395,070	4,395,010	4,394,890	4,394,840	4,394,830
SPECIES																																									
Sand Shiner								x			x				x																		x			x				x	
Bigmouth Shiner								x																												x					
Red Shiner						x	x																		x					x	x	x	x		x	x		x			
Redfin Shiner					x		x												x													x								
Bluntnose Minnow			x	x		x	x											x	x	x					x						x	x	x		x	x		x			
Fathead Minnow																																									
Central Stoneroller		x	x		x	x	x				x				x						x		x	x	x			x	x	x	x	x	x		x	x				
Creek Chub		x					x								x			x				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x
White Sucker																		x					x			x		x					x	x	x		x	x			x
Black Bullhead																	x						x																		
Yellow Bullhead																													x												
Largemouth Bass										x										x		x												x	x				x		x
Spotted Bass		x		x			x											x			x		x		x	x						x			x	x			x		
Bluegill		x					x		x	x						x	x	x	x	x	x		x	x	x	x		x	x	x	x	x		x	x	x	x		x		x
Green Sunfish		x								x											x			x	x			x		x	x	x		x							x
Black Crappie																																									
Johnny Darter										x														x										x				x		x	
Species/Pool	0	5	2	2	2	3	7	2	1	4	2	0	0	0	3	1	2	5	3	3	4	2	6	5	7	4	1	5	4	5	6	8	6	6	8	8	3	5	4	2	5

Indiana and Northern Long-eared Bat Study

Survey of Summer Bat Activity to Determine Presence or Probable Absence of Indiana Bats (*Myotis sodalis*) and Northern Long-eared Bats (*Myotis septentrionalis*) at a Proposed Reservoir Site in Caldwell County, Missouri

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EXECUTIVE SUMMARY

From May 27 to June 22, 2015, a Missouri State University research team conducted a mist net survey for bats near Hamilton, Missouri in Caldwell County. This survey was designed to determine the presence or probable absence of the federally endangered Indiana bat (*Myotis sodalis)* and the federally threatened Northern long-eared bat (*Myotis septentrionalis*). If presence was confirmed of either or both species, roost tree locations would be determined and surveyed. This survey was conducted after a proposal to install a dam and create a reservoir along the Little Otter Creek area. A total of 7 mist net sites (4 net nights each) were required for the proposed survey. Two nights of acoustic detector data at each site were also required. Acoustic data were classified using Bat Call Identification Software (BCID) and Kaleidoscope software. Calls classified as Indiana or Northern long-eared bats were visually inspected to confirm identifications. Suitable sites included forest patches with riparian woodland and water availability. Some nets were established along forest edges adjacent to agricultural fields.

Mist-nets were used to document the presence of bat species in the area. Methodology was based on the guidelines in the Indiana Bat Revised Recovery Plan and the Draft Recovery Plan (USFW, 2007, 2015). Two species were captured in mist nets (*Eptesicus fuscus* and *Lasiurus borealis*). Twelve bats were captured in mist nets, all *Lasiurus borealis* except for one *Eptesicus fuscus*. Nine species of bat (*Eptesicus fuscus, Lasionycteris noctivagans, Lasiurus borealis, Lasiurus cinereus, Myotis lucifugus, Myotis sodalis, Nycticeius humeralis,* and *Perimyotis subflavus*) were classified from calls using Bat Call Identification Software (BCID). Eleven species of bats (*Eptesicus fuscus, Lasionycteris noctivagans, Lasiurus borealis, Lasiurus cinereus, Myotis lucifugus, Myotis septentrionalis, Myotis sodalis, Nycticeius humeralis,* and *Perimyotis subflavus*) were classified from calls using Kaleidoscope identification software. While BCID classified 9 calls as Indiana Bat calls, none of these were able to be confirmed during visual examination. Kaleidoscope classified one call as a Northern long-eared bat and 4 calls as Indiana Bats, but none of these calls were able to be confirmed during visual examination.

The probable absence of Indiana bats and Northern long-eared bats was determined after a total of 29 net nights and 17 detector nights within the project boundaries.

INTRODUCTION

Area Description

The project area is located in western Missouri within Caldwell County. The site was primarily vacated agricultural area, with a flowing creek surrounded by thick patches of riparian forest. Open areas contained a mixture of grasses and fallow fields, while forests were primarily oak and other hardwoods with dense understory vegetation. Little Otter Creek flowed through or near all sites surveyed. The creek was between a few inches to several feet deep depending on the location.

Indiana Bats

Indiana bats have been listed as an endangered species since 1966 and even with the discovery of additional hibernacula within the KY/MO portion of their range, estimated populations are still

below historical levels. Both habitat and contaminant sources have been attributed to declining populations, and recent reports of white-nose fungus devastating hibernating bats in the eastern U.S. has raised alarm among bat professionals. Indiana bats utilize karst regions for cave hibernating habitat and depend on the connectivity and conservation of roosting habitat and foraging and migration corridors (USFW, 2007). Indiana bats favor maternity roosts in large dead or dying trees with a high degree of solar exposure and are known to forage in agricultural areas in Missouri. Often, these roosts are found either adjacent to forest clearings or above canopy gaps (Dey, 2009). A preliminary desktop survey of the area indicated that it does contain potentially suitable habitat for Indiana bats and Northern long-eared bats.

Northern Long-eared Bats

As of April 2, 2015, the U.S. Fish and Wildlife Service (FWS) listed the Northern long-eared bat as threatened under the Endangered Species Act (ESA). The guidelines for assessing presence or probable absence of Northern long-eared bats are stated in the Indiana bat Summer Survey Guidelines (USFWS, 2015).

The 2007 Indiana Bat Draft Recovery Plan (USFWS, 2007) and the Range-Wide Indiana Bat Summer Survey Guidelines (USFWS, 2015) have compiled available information on known characteristics of summer, fall, and wintering life history needs and described the guidelines for determining presence or presumed absence and for determining habitat use and roost tree characteristics. The guidance document for Northern Long-eared Bats provides similar recommendations for surveys (USFW, 2014). All activities described in this project have been approved by of the U.S. Fish and Wildlife Service.

Project Investigators

The principal investigator is Dr. Lynn W. Robbins, professor in the Department of Biology at Missouri State University, Springfield, Missouri. Dr. Robbins has completed a study on the management of habitat relating to the presence of Indiana bats at Ozarks National Scenic Riverways (NPS). He has been investigating Indiana bats since 2001; however his research includes all bat species in Missouri with evaluations of dormant season fire effects on ground-dwelling bats in Missouri Department of Conservation lands. The principal investigator has completed studies in northern Missouri and was successful in locating maternity colonies and radio-tracking Indiana bats, Northern Long-eared bats and other species to determine foraging patterns and habitat associations. He is familiar with U.S. Fish and Wildlife Service endangered species regulations and with the communities and habitats of the Ozark region. He and his graduate students are currently working on White-Nose Syndrome related projects including analyses of acoustic data, band returns, and radio-telemetry to determine movements of Gray Bats from hibernacula to maternity sites. He currently holds all necessary federal and state permits. Dr. Robbins is a research associate with the Indiana State University Center for North American Bat Research and Conservation and Research Coordinator for Springfield's Dickerson Park Zoo. Cheyenne Gerdes and Ben Smith are graduate students at MSU with qualifications to be included on Robbins' endangered species recovery permit issued by the USFWS. Dana Green and Eric Green are graduates of Missouri State University with bachelor degrees in biology and have been trained to work with bats under the guidance of Dr. Robbins.

SURVEY METHODOLOGY

Survey methods were based on a standardized protocol (USFWS, 1999, 2007; Carroll et al., 2002; Robbins et al., 2008). To adequately sample the project area, seven mist-net sites were selected (Figure 1-14) by identifying areas that had favorable bat habitat (upland deciduous forest blocks, riparian woodland, streams, or ponds) based on examination of aerial photos and ground searches. After survey sites were chosen, various sized mist-nets (4, 6, 9, and 12 meter) (Avinet, Dryden, New York) at heights of one, two or three nets high, were used to document bat species in the area (Figure 10). Each site had a minimum of two mist nets, though site 3 had three mist net locations active on May 29. Nets 1 and 2 of site 3 were not netted a second time, as they did not catch any bats the first night and were replaced with site 3 net 4. The location of each net was recorded with a DeLorme Earthmate PN-60 GPS unit (Delorme, Yarmouth, Maine).

Mist-nets were set prior to sunset, and opened approximately at sunset each night. Nets remained open a minimum of five hours (from approximately 20:30 hrs until 01:30 hrs). Researchers remained within walking distance (approximately 40 feet to 700 feet) of mist-nets so that nets were constantly surveyed. Each net was checked with flashlights at a minimum of 10-minute intervals, and any captured bats were immediately removed for processing. Bats were transported to processing tables in cloth bags to reduce stress of paper bag transport, and were released at capture site immediately after processing. The location of capture, net of capture, and time of capture were recorded for each bat. Additional data were measured and recorded including species, sex, age, reproductive status, mass, forearm length, and white-nose score (0-3) (USFWS, 2012). White-nose syndrome disinfection protocols were followed in accordance with the USFWS (USFWS, 2012). All *Myotis* species were banded with aluminum clamp "INB" bands. The eastern red bats and big brown bat captured were not banded because of the known ability for individuals of the species to remove their bands and harm themselves in the process.

For the purpose of this study, a detector night is defined as one detector, placed to survey for one night at a specific site. Each site required a minimum of two detector nights. Anabat II and SongMeter 3 detectors were set prior to sunset and bat calls were recorded from approximately sunset (20:30 hours) until 5 hours later. Anabat detectors were placed on a stand approximately 2 feet off the ground with a cone funnel aimed upward at 45 degrees. The sensitivity of each device was site specific, based on the amount of ambient noise, and ranged from about 5 to 7. Division ratio was set to 16. Song Meter (SM3, Wildlife Acoustics) detector set-ups were positioned using external microphones that were raised on extendable poles at least 1.5 meters off the ground. These detectors were set to record on the default sensitivity in the full spectrum format which would be converted to zero crossing, using Kaleidoscope V 3.0, for analysis. An example detector setup can be seen in Figure 24.

All Anabat detectors were equipped with a two or four gigabyte compound flash (CF) card for storing recorded calls. All detector data were downloaded from CF cards following each detector night. Call data was converted into individual time stamped call files using CFread software (Titley Scientific, Ballina, New South Wales, Australia). SongMeter calls were equipped with a standard SD card. Call sequences were identified to species level by comparing call structure to

known calls using Bat Call Identification (BCID) software (Allen et al., 2008) and Kaleidoscope Pro (Wildlife Acoustics, Inc.) Calls identified by BCID required a minimum of five consecutive identifiable pulses. Calls identified in Kaleidoscope required a minimum of 2 consecutive pulses and a signal frequency between 16 and 120 kHz. Due to similarities between the calls of some species, some bat passes were unable to be identified and were classified as unknown. All call sequences identified by either program as an Indiana bat or Northern Long-eared bat call were then examined visually and compared to known call sequences to confirm or reject the computer models' identifications.

RESULTS

Survey Effort

Seven sites within the project were surveyed with mist-nets for four net nights each. Two nets (Site 3, nets 1-2) were used only on May 29. Total survey effort for the project was 29 net nights and 17 detector nights over the course of 7 days (May 27, May 29 – June 2, June 22). One net night is defined as one net used for one night. One detector night is defined as one detector, placed to survey for one night at a specific site. Maps of survey effort can be found in Figure 16-18. A summary of the survey effort is presented in Table 1 and Table 2.

Net Captures

A total of 12 bats (11 Eastern red bats and 1 big brown bat) were captured during 29 net nights. These individuals are represented by site of capture in Table 2. The reproductive status of bats from each site are represented in Table 4. Images of each species captured can be seen in Figures 19-23. In addition, one flying squirrel, *Glaucomys volans*, was captured in a net at site 2 on June 22.

Radio Telemetry

No target bats were captured on the area, and thus no radio telemetry surveys were performed.

Acoustic sampling

An example of a detector setup on this project can be seeing in Figure 24.

Nine species of bat (*Eptesicus fuscus*, *Lasionycteris noctivagans*, *Lasiurus borealis*, *Lasiurus cinereus*, *Myotis lucifugus*, *Myotis sodalis*, *Nycticeius humeralis*, and *Perimyotis subflavus*) were classified from calls using Bat Call Identification Software (BCID). Eleven species of bats (*Eptesicus fuscus*, *Lasionycteris noctivagans*, *Lasiurus borealis*, *Lasiurus cinereus*, *Myotis lucifugus*, *Myotis septentrionalis*, *Myotis sodalis*, *Nycticeius humeralis*, and *Perimyotis subflavus*) were classified from calls using Kaleidoscope identification software. While BCID classified 9 calls as Indiana Bat calls, none of these were able to be confirmed during visual examination. Kaleidoscope classified one call as a Northern long-eared bat and 4 calls as Indiana Bats, but none of these calls were able to be confirmed during visual examination.

Detailed acoustic results can be seen in Table 5.

DISCUSSION

No Indiana Bats or Northern Long-eared Bats were captured on site. Red bats were entering lactation, and a bat captured on May 29 represents one of the earliest known instances of lactation in red bats in the state.

The identification software BCID classified 9 calls as Indiana bats, Kaleidoscope classified 1 call as a Northern long-eared bat and 4 calls as Indiana bats. Visual inspection of these calls was unable to confirm that any of these calls belonged to target species.

ACKNOWLEDGEMENTS

We would like to thank Ben Spitz and Ian Bell for their field assistance.

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Table 1. Table of Survey Effort (Net and Detector)

Name	Category	Type	Date1	Date2
OC site 1 net 1	Net	3x9	5/27/2015	6/22/2015
OC site 1 net 2	Net	2x9	5/27/2015	6/22/2015
OC site 2 net 1	Net	3x6	5/27/2015	6/22/2015
OC site 2 net 2	Net	2x4	5/27/2015	6/22/2015
OC site 3 net 1	Net	3x12	5/29/2015	6/22/2015
OC site 3 net 2	Net	2x4	5/29/2015	n/a
OC site 3 net 3	Net	2x6	5/29/2015	n/a
OC site 3 net 4	Net	3x12	n/a	6/22/2015
OC site 4 net 1	Net	2x6	5/30/2015	5/31/2015
OC site 4 net 2	Net	3x9	5/30/2015	5/31/2015
OC site 5 net 1	Net	2x9	5/30/2015	5/31/2015
OC site 5 net 2	Net	3x12	5/30/2015	5/31/2015
OC site 6 net 1	Net	2x9	6/1/2015	6/2/2015
OC site 6 net 2	Net	3x12	6/1/2015	6/2/2015
OC site 7 net 1	Net	3x6	6/1/2015	6/2/2015
OC site 7 net 2	Net	2x6	6/1/2015	6/2/2015
OC det 1	Detector	SM3	5/27/2015	n/a
OC det 2	Detector	AB	5/27/2015	6/22/2015
OC det 3	Detector	AB	5/27/2015	6/22/2015
OC det 4	Detector	AB	5/29/2015	n/a
OC det 5	Detector	AB	5/29/2015	n/a
OC det 6	Detector	AB	5/30/2015	5/31/2015
OC det 7	Detector	AB	5/30/2015	n/a
OC det 8	Detector	AB	n/a	5/31/2015
OC det 9	Detector	SM3	n/a	5/31/2015
OC det 10	Detector	AB	6/1/2015	6/2/2015
OC det 11	Detector	AB	6/1/2015	6/2/2015
OC det 12	Detector	SM3	6/1/2015	n/a

AB = Anabat

SM3 = SongMeter

Table 2. Table of Survey Effort (Net and Detector) by Site

Name	# of Nets	# Net Nights	Detector #'s	Total Detector Nights
Site 1	2	4	1, 2	3
Site 2	2	4	3	2
Site 3	4	5	4, 5	2
Site 4	2	4	6, 9	3
Site 5	2	4	7, 8	2
Site 6	2	4	10	2
Site 7	2	4	11, 12	3
Total:	16	29	-	17

Table 3. Total captures by site.

Net	**Eastern Red Bat**	**Big Brown Bat**	**Totals**
Site 1 Net 1	1	0	1
Site 1 Net 2	0	0	0
Site 2 Net 1	1	1	2
Site 2 Net 2	0	0	0
Site 3 Net 1	1	0	1
Site 3 Net 2	0	0	0
Site 3 Net 3	0	0	0
Site 3 Net 4	1	0	1
Site 4 Net 1	3	0	3
Site 4 Net 2	1	0	1
Site 5 Net 1	1	0	1
Site 5 Net 2	2	0	2
Site 6 Net 1	0	0	0
Site 6 Net 2	0	0	0
Site 7 Net 1	0	0	0
Site 7 Net 2	0	0	0
Totals	**11**	**1**	**12**

Table 4. Reproductive status and age of captured bats.

Species	Common Name	Males			Females				
		Total	**Adult**	**Juv.**	**Total**	**Adult**	**Juv.**	**P**	**L**
Lasiurus borealis	Eastern Red Bat	2	2	0	9	9	0	5	4
Eptesicus fuscus	Big Brown Bat	1	1	0	0	0	0	0	0
	Totals	**3**	**3**	**0**	**9**	**9**	**0**	**5**	**4**

P= pregnant
L= lactating

Table 5. Summary of classified calls from BCID and Kaleidoscope.*

	EPFU		LANO		LABO		LACI		MYGR		PESU	
	BCID	Kscope	BCID	Kscope	BCID	Kscope	BCID	Kscope	BCID	Kscope	BCID	Kscope
Det 1	1	0	0	0	4	5	0	0	0	0	0	0
Det 2	2	7	5	3	22	36	4	9	2	0	1	1
Det 3	0	1	0	0	2	7	0	3	0	0	0	0
Det 4	1	4	1	2	8	29	5	3	0	0	0	0
Det 5	1	0	0	1	5	7	1	4	0	0	1	1
Det 6	10	12	0	3	34	73	0	1	5	2	2	0
Det 7	1	3	0	0	1	6	0	2	0	0	0	0
Det 8	0	0	0	1	0	7	0	3	0	1	1	1
Det 9	0	0	1	0	4	10	1	4	2	0	0	0
Det 10	3	1	3	3	19	43	1	2	0	0	1	0
Det 11	1	0	1	0	2	6	0	0	0	0	0	0
Det 12	0	0	0	0	4	4	0	2	0	0	0	0

	MYLE		MYLU		MYSE		MYSO		NYHU	
	BCID	Kscope	BCID	Kscope	BCID	Kscope	BCID	Kscope	BCID	Kscope
Det 1	0	0	1	1	0	0	0	1	0	3
Det 2	0	0	0	1	0	0	5	1	4	6
Det 3	0	0	1	2	0	0	0	0	1	1
Det 4	0	0	0	0	0	0	0	0	7	7
Det 5	0	0	0	0	0	0	0	0	3	7
Det 6	0	0	2	1	0	1	3	2	22	18
Det 7	0	0	0	0	0	0	0	0	1	0
Det 8	0	1	0	0	0	0	1	0	2	2
Det 9	0	0	0	0	0	0	0	0	2	4
Det 10	0	0	0	0	0	0	0	0	11	10
Det 11	0	0	0	0	0	0	0	0	3	4
Det 12	0	0	0	0	0	0	0	0	2	4
					# confirmed:		# confirmed:			
					0	0	0	0		

*Abbreviations represent the first two letters of the genus and species, for example, EPFU stands for *Eptesicus fuscus*. Gray bats (MYGR) and small footed Myotis (MYLE) are included in this table, but are not known to occur in this area of Missouri and were also excluded using visual analyses.

Figure 1. Creek with 3x9 meter net at site OC Site 1 Net 1.

Figure 2. Creek with 2x9 meter net at OC Site 1 Net 2.

Figure 3. Creek with 3x6 meter net at OC Site 2 Net 1.

Figure 4. Creek with 2x4 meter net at OC Site 2 Net 2.

Figure 5. Forest edge with 2x12 meter net at OC Site 3 Net 1.

Figure 6. Creek with 2x4 meter net at OC Site 3 Net 2.

Figure 7. Creek with 2x6 meter net at OC Site 3 Net 3.

Figure 8. Forest flyway with2x6 net at OC Site 4 Net 1.

Figure 9. Forest flyway with 3x9 meter net at OC Site 4 Net 2.

Figure 10. Creek with 2x9 meter net at OC Site 5 Net 1.

Figure 11. Forest edge with 3x12 meter net at OC Site 5 Net 2.

Figure 12. Forest flyway with 2x9 meter net at OC Site 6 Net 1.

Figure 13. Forest edge with 3x12 meter net at OC Site 6 net 2.

Figure 14. Forest flyway with 3x6 meter net at OC Site 7 net 1.

Figure 15. Creek with 2x6 meter net at OC Site 7 net 2.

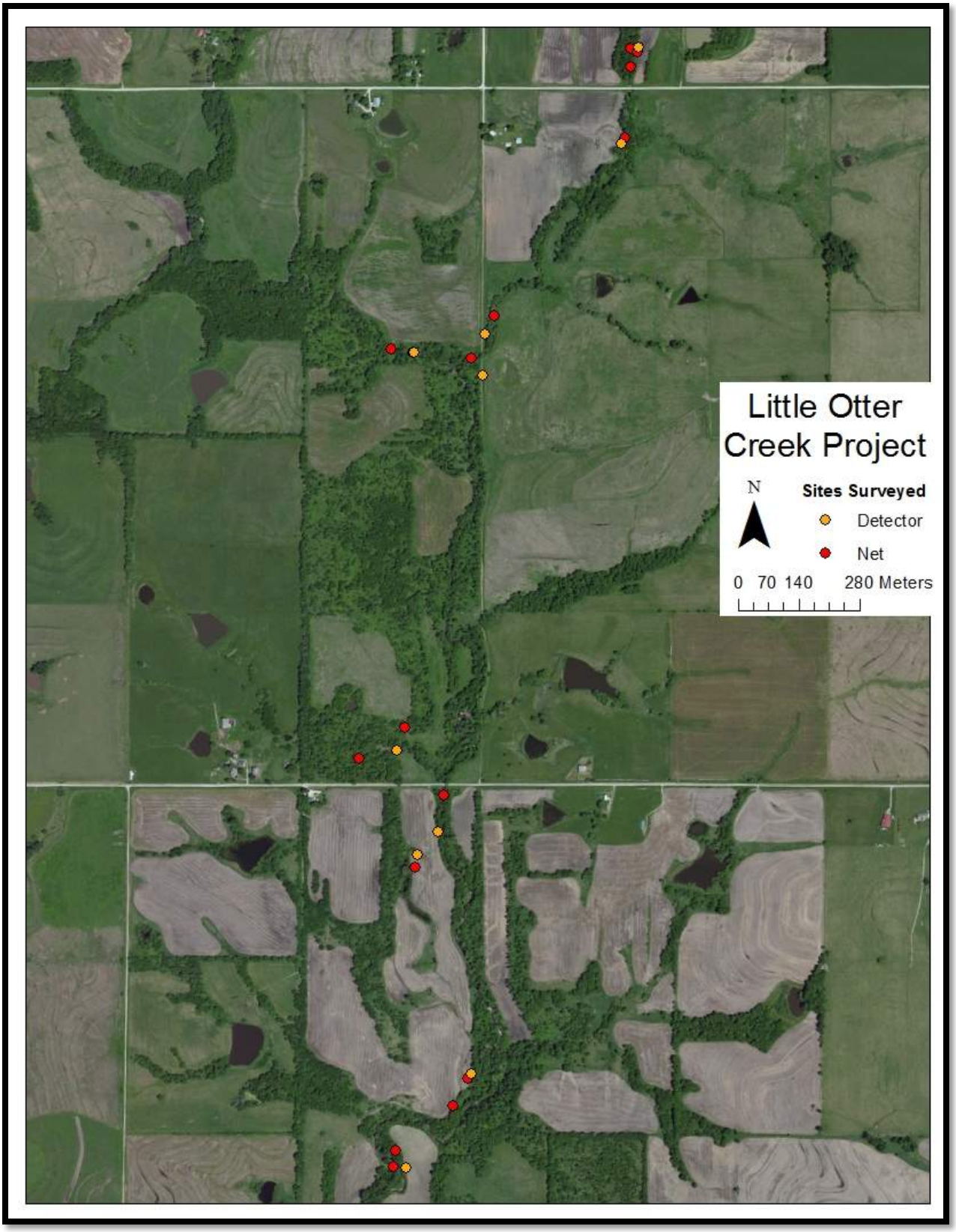

Figure 16. Map of entire project area showing all sites surveyed.

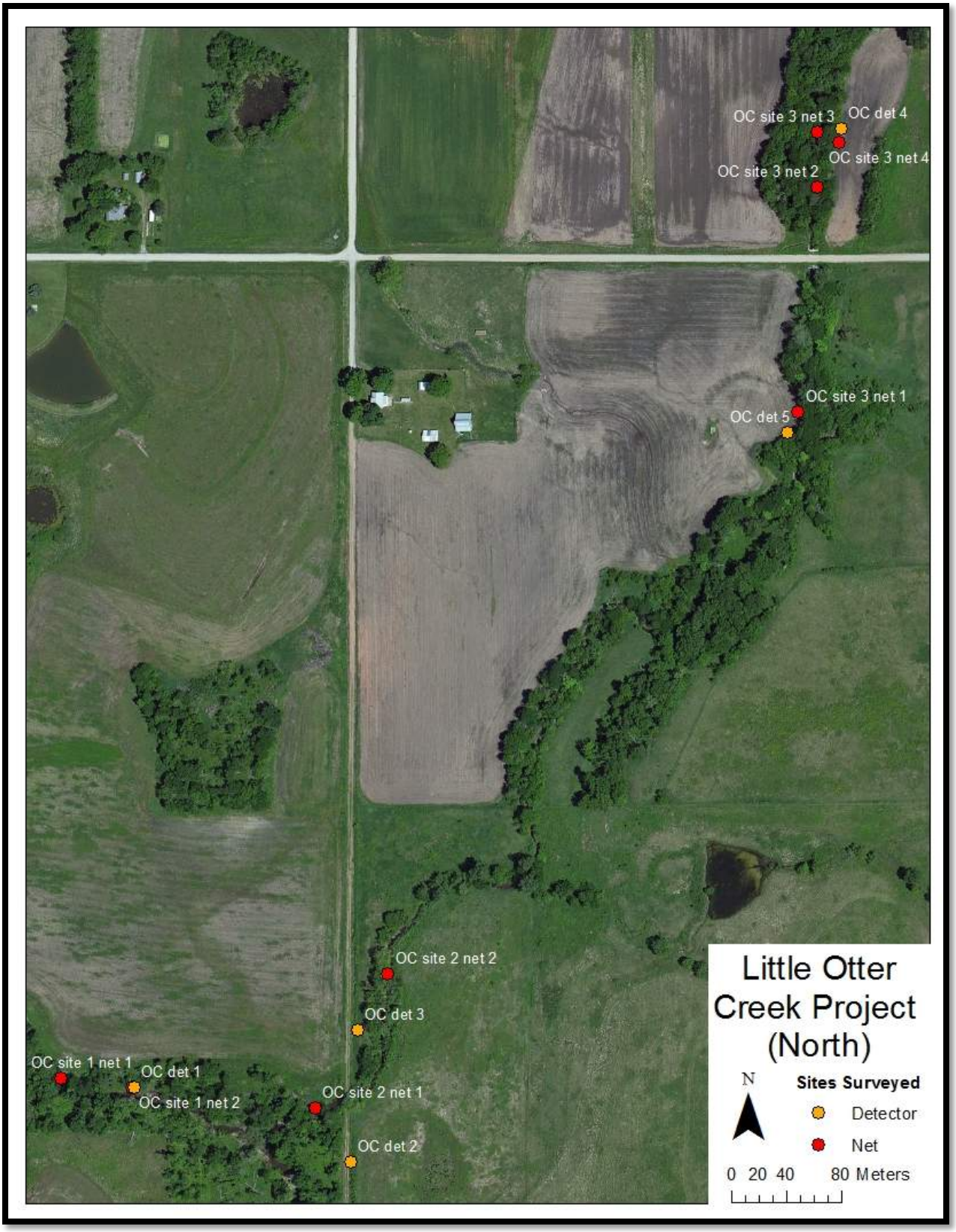

Figure 17. Map of northern section of project, showing areas surveyed, with labels

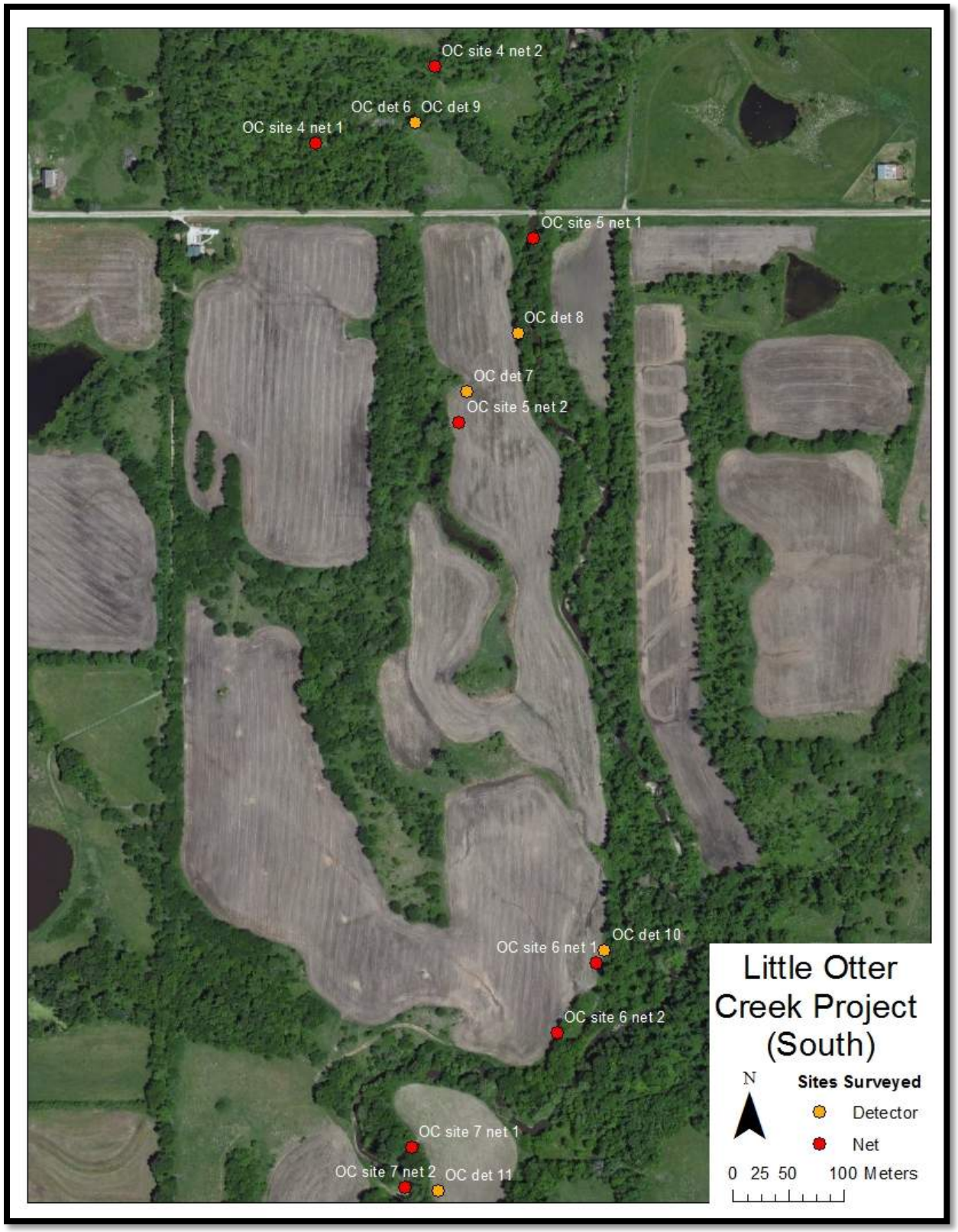

Figure 18. Map of southern section of project, showing areas surveyed, with labels

Figure 19. Red bat (*Lasiurus borealis*) captured at Site 1 Net 1.

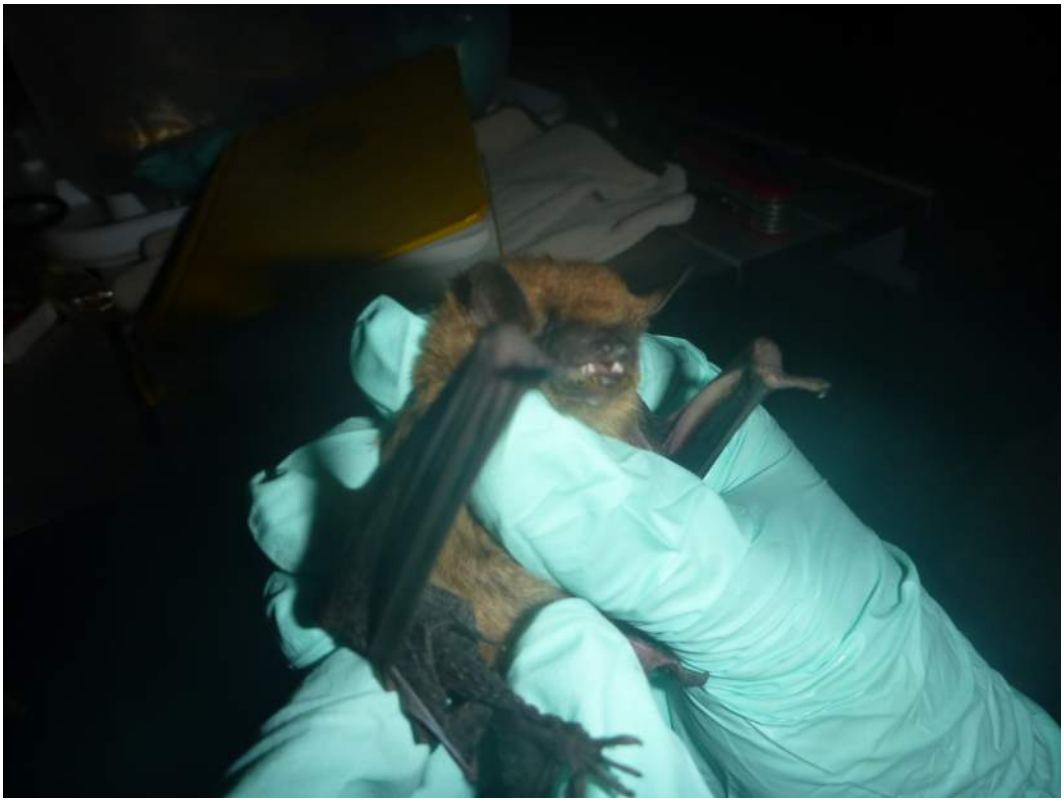

Figure 20. Big brown bat (*Eptesicus fuscus*) captured at Site 2 Net 1.

Figure 21. Red bat (*Lasiurus borealis*) captured at Site 3 Net 1.

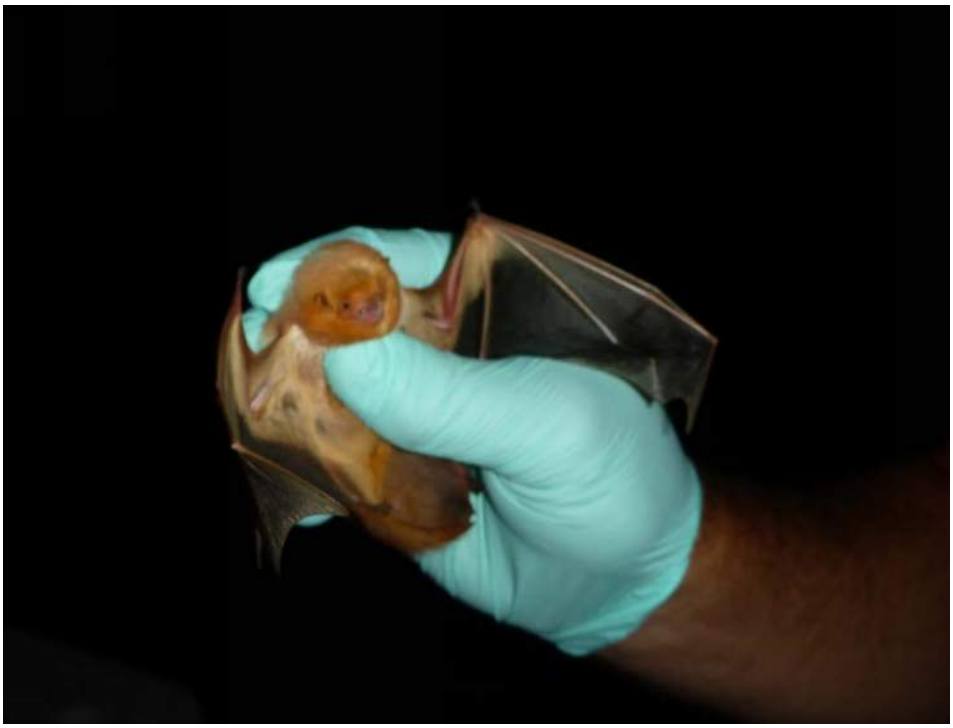

Figure 22. Red bat captured at Site 4 Net 1.

Figure 23. Lactating female Eastern red bat (*Lasiurus borealis*) captured at Site 4 Net 2.

Figure 24. Representative Anabat detector setup (Detector 10).

Appendix B

Opinions of Probable Cost

Included in this appendix are the detailed estimates of probable cost for each alternative meeting the screening criteria in the SEIS Little Otter Creek Watershed Revised Plan. Unit prices in each detailed estimate include labor, materials, and equipment required to complete the work for each alternative and are described below.

Construction

Mobilization, Bonding, and Insurance

This item shall consist of preparatory work and operations including, but not limited to, those necessary for the movement of personnel, equipment, and incidentals to the project site; for the establishment of all offices, buildings, and other necessary facilities for the movement of personnel; for the establishment of all offices, buildings, and other facilities necessary for work on the project except as provided in the contract as separate bid items; for all other work on the various items on the project site; for periodic cleanup during construction; and for cleanup upon completion of the work.

The cost for this line item is 8 percent of the total construction costs, excluding contingency.

Clearing and Grubbing

This item consists of clearing and grubbing within a 75-foot-wide corridor along the centerline of the raw water main (37.5 feet on each side), and along the site for each intermediate pump station and any other site needed for each alternative. Clearing and grubbing includes the complete removal and disposal of all buildings, timber, brush, stumps, roots, rubbish, debris, and all other obstructions resting on or protruding through the surface of the existing ground and the surface of excavated areas; and all other structures and obstructions necessary to be removed for which other items do not specify the removal thereof, including building foundations and pipes.

Clearing and grubbing is a measured quantity and is estimated at $10,000 per acre.

Structural Earth Fill

Structural earth fill consists of the work associated with preparing the foundation of the dam embankment; spreading, harrowing, sprinkling, compacting, removing objectionable materials; and all other incidental work required for the construction, protection, and maintenance of the dam embankment. The volume of structural earth fill will be measured to the nearest cubic yard by the method of average cross-sectional end areas needed for the dam embankment.

Structural earth fill is a measured quantity and is estimated at $6.00 per cubic yard.

Riprap

This item includes all labor, materials, and equipment necessary to excavate, prepare subgrade, and install rock riprap for the dam embankment. The rock riprap will be used to protect the dam embankment from wave erosion.

Riprap is a measured quantity and is estimated at $65 per cubic yard.

Instrumentation

This item includes all piezometer, settlement gages, movement markers, and other miscellaneous materials and equipment necessary to furnish and install all instrumentation needed for the intake structure. This item will be measured as a lump sum.

Instrumentation is a lump sum quantity and is estimated at $20,000.

Spillway

This line item includes the excavation, concrete, reinforcing steel, fence, and other miscellaneous materials and equipment necessary for a fully functioning spillway.

The spillway is a lump sum quantity and is estimated at $440,000.

Intake Structure

This line item includes concrete, reinforcing steel, gates, wall thimbles, pipe, doors, hatches, ladders, controls, trash racks, grating, and all other miscellaneous materials and equipment needed for a fully functioning intake structure. The intake structure will be measured as a lump sum.

The intake structure is a lump sum quantity and is estimated at $425,000.

Contractor Construction Staking

Contractor construction staking will be used to provide surveying services and to set the right-of-way survey monuments consistent with surveying practices.

Contractor construction staking is a lump sum quantity and is estimated at $365,000.

Erosion Control

Erosion control must be used to provide sufficient control of erosion to prevent migration of sediment off the construction site throughout the duration of the project. This would include the labor, materials, and equipment necessary to establish erosion control at the construction site.

Erosion control is a lump sum quantity and is estimated at $83,000.

Intermediate Booster Pump Station

The intermediate booster pump station is used to transfer water from the source to the Water Treatment Plant for each option. This item includes all labor, materials, and equipment necessary for a fully functioning intermediate pump station. Electrical service and telemetry costs are also included in this line item.

Intermediate booster pump stations are a measured quantity and are estimated at $750,000 each.

16-inch Raw Water Main

This item includes all excavation, pipe material, bedding, trench checks, placing, fittings, pipe-to-pipe connections, sealing, backfilling, compacting, grading, and removal of excess or unsuitable backfill material.

The 16-inch raw water main is a measured quantity and is estimated at $120 per linear foot (LF).

16-inch Directional Boring

This item includes all excavation, bedding, trench checks, placing, fittings, boring, end seals, backfilling, compacting, grading, and removal of excess or unsuitable material.

The measurement for this line item is based on the total number of stream crossings for the raw water main. Whether a stream will require boring is based on the stream classification. Stream classifications 1-3 will be open cut. Stream classifications 4-6 will have an assumed depth of bore of 20 feet, for a total bore length of 1,300 LF per crossing.

The 16-inch directional boring is a measured quantity and is estimated at $300 per LF.

24-inch Directional Boring

This item includes all excavation, bedding, trench checks, placing, fittings, boring, end seals, backfilling, compacting, grading, and removal of excess or unsuitable material.

The measurement for this line item is based on the total number of road crossings for the raw water main. If the road crossing is gravel it is assumed the road would be open-cut and boring would not be necessary. Twenty-four-inch boring is only calculated for paved road crossings. The total length of bore for 24-inch borings is assumed to be 200 LF.

The 24-inch directional boring is a measured quantity and is estimated at $500 per LF.

24-inch Steel Encasement

This item includes all excavation, bedding, trench checks, placing, fittings, boring, casing spacers, end seals, backfilling, compacting, grading, and removal of excess or unsuitable material.

The 24-inch steel encasement is a measured quantity and is estimated at $600 per LF.

16-inch Valves

This bid item shall include all labor and materials, equipment, excavation, backfill, and incidental items to complete the work. This also includes the cost for air release valves for the transmission main. It is assumed that one 16-inch valve will be needed for every mile of transmission main.

Sixteen-inch valves are a measured quantity and are estimated at $16,000 each.

Access Roads

The measurement for this line item assumes 0.05 mile of access road is needed for all intermediate pump stations and 16-inch valves. The payment includes all labor, materials, equipment, excavation, backfill, and incidental items to complete the work.

Access roads are a measured quantity and are estimated at $75,000 per mile.

Road Repairs

The measurement for this line item is based on the amount of road crossings that would be open cut. It is assumed that all gravel roads that are crossed will be open cut. It is also assumed each gravel crossing has a length of 5 feet and a width of 25 feet.

Road repairs are a measured quantity and are estimated at $75 per square yard.

Cleanup, Finish Grading, Seeding, and Mulch

This item consists of cleanup, finish grading, seeding, and mulch within a 75-foot-wide corridor along the centerline of the raw water main (37.5 feet on each side), and along the site for each intermediate pump station and any other site needed for each alternative.

Cleanup, finish grading, seeding, and mulch is a measured quantity and is estimated at $7,500 per acre.

Miscellaneous Dam Appurtenances

This item includes abutment grouting, subsurface anomalies, subgrade stabilization/replacement, isolated French drains or blanket drains, or other isolated mitigation actions necessary to ensure long-term stability and safe operation of the dam.

The miscellaneous dam appurtenances are a lump sum quantity and the cost varies depending on the alternative.

Engineering Services

The engineering service cost for the project is estimated at 10 percent of the total construction cost for the project, including contingency.

Other Professional Services and Miscellaneous

Appraisal / Descriptions

Appraisal costs are a measured quantity and are estimated at 10 percent of total land acquisition costs.

Land Acquisition

The measurement for this line item is based on the amount of land to be purchased for the project. This includes the land needed for the raw water main, intermediate booster pump stations, and reservoir (if needed). It is assumed that 50 feet would be needed for the entire length of the raw water main, 1 acre per intermediate booster pump station, and 1.5 times the total “normal pool” lake acreage.

Land acquisition is a measured quantity and is estimated at $2,900 per acre.

Recreation Cost

Parking Lot Drive Lane Construction

This line item includes the excavation, subgrade, concrete, asphalt, and other miscellaneous materials needed for the construction of a parking lot drive lane.

The parking lot drive lane construction is a measured quantity and is estimated at $96,300 per drive lane.

Parking Lot

This line item includes the excavation, subgrade, concrete, asphalt, and other miscellaneous materials needed for the construction of a parking lot.

The parking lot is a measured quantity by number of parking spaces needed. This is estimated at $1,620 per parking space.

Mitigation

Mitigation cost is a lump sum opinion of possible mitigation cost for the project, with a basis assumption of $70,000/acre of permanently disturbed wetland and $60/LF permanently disturbed stream channel. This conceptual opinion of cost is rounded to the nearest $50,000.

Project Installation Costs and Project Present Worth Value

The Project Installation Cost was developed for each technically feasible alternative, and presented in the document.

The project present worth value (PPWV) was also calculated as the sum of the project installation cost (PIC) plus the project present worth of uniform series of annual operation and maintenance cost (PO&M) minus the salvage value (S). This equation can be found in the *USDA Bulletin 1780-2* page 13.

$$PPWV = PIC + PO\&M - S$$

The project installation cost is the sum of construction, engineering services, other professional services, and recreation costs needed for the project as shown in the detailed estimates. The project installation cost is also called project capital cost in USDA Bulletin 1780-2.

There are two separate items added together to get the total PO&M value. The first is the annual transmission line electrical cost. This cost is based on $0.10 per kilowatt hour, with a 1.1 peaking factor. The second value is the annual reservoir and transmission line labor and equipment cost. This cost was based on 0.4 percent of the total construction cost for the alternative. Also included in this calculation was a discount rate. The discount rate that used was 6.125 percent.

The salvage value is the total value of the land needed for the project.

City of Plattsburg Water Supply (WA5)

This alternative is described in Section 2. A 169,000-LF raw water main constructed from the City of Plattsburg water system to the location of the proposed water treatment plant. This would require an estimated one intermediate booster station, 14,300 LF of 16-inch directional boring, 19,800 LF of 24-inch directional boring with steel encasement, 33 16-inch valves, 2 miles of access roads, 348 square yards of road repairs, and 194 acres of cleanup, finish grading, seeding, and mulch. This alternative provides a water supply that requires a water treatment plant.

Water Supply Alternative					
Opinion of Probable Project Cost					
City of Plattsburg Water Supply (WA5)					
1.00	**Construction**	**Quantity**	**Unit***	**Unit Cost**	**Total**
1.01	Mobilization, Bonding, Insurance	1	LS	$3,774,000	$3,774,000
1.02	Clearing and Grubbing	200	Acres	$10,000	$2,000,000
1.03	Intermediate Booster Pump Station	1	Each	$750,000	$750,000
1.04	16-inch Raw Water Main	134,900	LF	$120	$16,188,000
1.05	16-inch Directional Boring	14,300	LF	$300	$4,290,000
1.06	24-inch Directional Boring	19,800	LF	$500	$9,900,000
1.07	24-inch Steel Encasement	19,800	LF	$600	$11,880,000
1.08	16-inch Valves	33	Each	$16,000	$528,000
1.09	Access Roads	2	Mi	$75,000	$150,000
1.10	Road Repairs	348	Sq. Yd.	$75	$26,100
1.11	Clean Up, Finish Grading, Seeding, Mulch	194	Acres	$7,500	$1,455,000
				Subtotal	$50,941,100
1.23	Contingencies (30% of Construction Total)				$15,282,400
				Construction Subtotal	**$66,223,500**
2.00	**Engineering Services (10% of Construction Subtotal)**			**Engineering Subtotal**	**$6,622,400**
3.00	**Other Professional Services & Miscellaneous**				
3.01	Appraisals / Descriptions (10% of Land Acquisition)				$56,300
3.02	Land Acquisition	194	Acres	$2,900	$562,600
				Other Professional Services and Miscellaneous Subtotal	**$618,900**
4.00	**Mitigation Cost**				
4.01	Mitigation	1	LS	$200,000	$200,000
				Mitigation Subtotal	**$200,000**
				PIC	**$73,660,000**
				PO&M	**$6,473,000**
				Salvage Value	**$562,900**
				PPWV	**$79,580,000**

*CY = Cubic Yards Mi = Miles LF = Linear Feet
SF = Square Feet LS = Lump Sum Sq. Yd. = Square Yards

Missouri River (WA6)

This alternative is described in Section 2. For this alternative, a 224,400-LF raw water main would be constructed from the Missouri River to the location of the proposed water treatment plant. This would require an estimated five intermediate booster stations, 13,000 LF of 16-inch directional boring, 20,400 LF of 24-inch directional boring with steel encasement, 43 16-inch valves, 3 miles of access roads, 362 square yards of road repairs, and 387 acres of cleanup, finish grading, seeding, and mulch. This alternative provides a water supply that would also require a water intake structure and a water treatment plant.

Water Supply Alternative					
Opinion of Probable Project Cost					
Missouri River (WA6)					
1.00	**Construction**	**Quantity**	**Unit***	**Unit Cost**	**Total**
1.01	Mobilization, Bonding, Insurance	1	LS	$4,822,200	$4,822,200
1.02	Clearing and Grubbing	300	Acres	$10,000	$3,000,000
1.03	Intake Structure	1	LS	$425,000	$425,000
1.04	Intermediate Booster Pump Station	5	Each	$750,000	$3,750,000
1.05	16-inch Raw Water Main	191,000	LF	$120	$22,920,000
1.06	16-inch Directional Boring	13,000	LF	$300	$3,900,000
1.07	24-inch Directional Boring	20,400	LF	$500	$10,200,000
1.08	24-inch Steel Encasement	20,400	LF	$600	$12,240,000
1.09	16-inch Valves	43	Each	$16,000	$688,000
1.10	Access Roads	3	Mi	$75,000	$225,000
1.11	Road Repairs	362	Sq. Yd.	$75	$27,200
1.12	Clean Up, Finish Grading, Seeding, Mulch	387	Acres	$7,500	$2,902,500
				Subtotal	**$65,099,900**
1.13	Contingencies (30% of Construction Total)				$19,530,000
				Construction Subtotal	**$84,629,900**
2.00	**Engineering Services (10% of Construction Subtotal)**			**Engineering Subtotal**	**$8,463,000**
3.00	**Other Professional Services & Miscellaneous**				
3.01	Appraisals / Descriptions (10% of Land Acquisition)				$76,300
3.02	Land Acquisition	301	Acres	$2,900	$762,700
				Other Professional Services and Miscellaneous Subtotal	**$839,000**
4.00	**Mitigation Cost**				
4.01	Mitigation	1	LS	$100,000	$100,000
				Mitigation Subtotal	**$100,000**
				PIC	**$94,030,000**
				PO&M	**$8,112,000**
				Salvage Value	**$762,700**
				PPWV	**$101,400,000**

*CY = Cubic Yards
LF = Linear Feet
LS = Lump Sum
Mi = Miles
SF = Square Feet
Sq. Yd. = Square Yards

Shoal Creek Pipeline and Offline Storage (WA7)

This alternative is described in Section 2. For this alternative, an 1,700-LF raw water main would be constructed from Shoal Creek to the location of the proposed treatment plant and offline storage. This would require an estimated one intermediate booster stations, 1 16-inch valve, 1 mile of access roads, and 3 acres of cleanup, finish grading, seeding, and mulch. The offline storage is anticipated to be excavated, and partially surrounded by berms, in an area near the Creek. This alternative provides a water supply that would also require a water intake structure and a water treatment plant.

Water Supply Alternative					
Opinion of Probable Project Cost					
Shoal Creek Pipeline and Offline Storage (WA7)					
1.00	**Construction**	**Quantity**	**Unit***	**Unit Cost**	**Total**
1.01	Mobilization, Bonding, Insurance	1	LS	$949,700	$949,700
1.02	Clearing and Grubbing	160	Acres	$10,000	$1,600,000
1.03	Excavation	1,291,000	CY	$6.80	8,778,800
1.04	Intake Structure	1	LS	$425,000	$425,000
1.05	Intermediate Booster Pump Station	1	Each	$750,000	$750,000
1.06	16-inch Raw Water Main	1,700	LF	$120	$204,000
1.07	16-inch Directional Boring	0	LF	$300	$0
1.08	24-inch Directional Boring	0	LF	$500	$0
1.09	24-inch Steel Encasement	0	LF	$600	$0
1.10	16-inch Valves	1	Each	$16,000	$16,000
1.11	Access Roads	1	Mi	$75,000	$75,000
1.12	Road Repairs	0	Sq. Yd.	$75	$0
1.13	Clean Up, Finish Grading, Seeding, Mulch	3	Acres	$7,500	$22,500
				Subtotal	**$12,821,000**
1.14	Contingencies (30% of Construction Total)				$3,846,300
				Construction Subtotal	**$16,667,300**
2.00	**Engineering Services (10% of Construction Subtotal)**			**Engineering Subtotal**	**$1,666,800**
3.00	**Other Professional Services & Miscellaneous**				
3.01	Appraisals / Descriptions (10% of Land Acquisition)				$18,300
3.02	Land Acquisition	63	Acres	$2,900	$182,700
				Other Professional Services and Miscellaneous Subtotal	**$201,000**
4.00	**Mitigation Cost**				
4.01	Mitigation	1	LS	$1,200,000	$1,200,000
				Mitigation Subtotal	**$1,200,000**
				PIC	**$19,740,000**
				PO&M	**$1,425,300**
				Salvage Value	**$182,700**
				PPWV	**$20,980,000**

*CY = Cubic Yards
LF = Linear Feet
LS = Lump Sum
Mi = Miles
SF = Square Feet
Sq. Yd. = Square Yards

Hamilton Lake Modification (WA10)

This alternative is described in Section 2. This includes a 500-LF raw water main constructed from Hamilton Lake to the location of the proposed water treatment plant replacement adjacent to Hamilton Lake. It would also require 1 16-inch valves, 1 mile of access road, 51 acres of cleanup, finish grading, seeding, and mulch. To raise the dam 10 feet this alternative also includes 2,400 cubic yards of structural earth fill, 200 cubic yards of riprap and $2,000,000 in miscellaneous dam appurtenances. This alternative provides a water supply that would also require a water intake structure and a water treatment plant.

Water Supply Alternative					
Opinion of Probable Project Cost					
Hamilton Lake Modification (WA10)					
1.00	**Construction**	**Quantity**	**Unit***	**Unit Cost**	**Total**
1.01	Mobilization, Bonding, Insurance	1	LS	$351,000	$351,000
1.02	Structural Earth Fill	2,400	CY	$6.00	$14,400
1.03	Riprap	200	CY	$65.00	$13,000.00
1.04	Miscellaneous Dam Appurtenances	1	LS	$2,000,000	$2,000,000
1.05	Intake Structure	1	Each	$425,000	$425,000
1.06	Intermediate Booster Pump Station	0	Each	$750,000	$0
1.07	Clearing and Grubbing	140	Acres	$10,000	$1,400,000
1.08	16-inch Raw Water Main	500	LF	$120	$60,000
1.09	24-inch Directional Boring	0	LF	$500	$0
1.10	24-inch Steel Encasement	0	LF	$600	$0
1.11	16-inch Valves	1	Each	$16,000	$16,000
1.12	Access Roads	1	Mi	$75,000	$75,000
1.13	Road Repairs	0	Sq. Yd.	$75	$0
1.14	Clean Up, Finish Grading, Seeding, Mulch	51	Acres	$7,500	$382,500
				Subtotal	$4,736,900
1.15	Contingencies (30% of Construction Total)				1,421,100
				Construction Subtotal	**$6,158,000**
2.00	**Engineering Services (10% of Construction Subtotal)**			**Engineering Subtotal**	**$615,800**
3.00	**Other Professional Services & Miscellaneous**				
3.01	Appraisals / Descriptions (10% of Land Acquisition)				$51,700
3.02	Land Acquisition	178	Acres	$2,900	$516,200
				Other Professional Services and Miscellaneous Subtotal	**$567,900**
4.00	**Mitigation Cost**				
4.01	Mitigation	1	LS	$2,250,000	$2,250,000
				Mitigation Subtotal	**$2,250,000**
				PIC	**$9,592,000**
				PO&M	**$401,200**
				Salvage Value	**$516,200**
				PPWV	**$9,477,000**

*CY = Cubic Yards
LF = Linear Feet
LS = Lump Sum
Mi = Miles
SF = Square Feet
Sq. Yd. = Square Yards

Breckenridge Lake Modification (WA11)

This alternative is described in Section 2. This alternative includes a 500-LF raw water main constructed from Breckenridge Lake to the location of the proposed water treatment plant. It would also require 1 16-inch valve, 1 mile of access road, and 10 acres of cleanup, finish grading, seeding, and mulch. To raise the dam 10 feet this alternative also includes 5,500 cubic yards of structural earth fill, 400 cubic yards of riprap and $2,000,000 in miscellaneous dam appurtenances. This alternative provides a water supply that would also require a water intake structure and a water treatment plant.

Water Supply Alternative					
Opinion of Probable Project Cost					
Breckenridge Lake Modification (WA11)					
1.00	**Construction**	**Quantity**	**Unit***	**Unit Cost**	**Total**
1.01	Mobilization, Bonding, Insurance	1	LS	$233,000	$233,000
1.02	Structural Earth Fill	5,500	CY	$6.00	$33,000
1.03	Riprap	400	CY	$65.00	$26,000.00
1.04	Miscellaneous Dam Appurtenances	1	LS	$2,000,000	$2,000,000
1.05	Intake Structure	1	Each	$425,000	$425,000
1.06	Intermediate Booster Pump Station	0	Each	$750,000	$0
1.07	Clearing and Grubbing	20	Acres	$10,000	$200,000
1.08	16-inch Raw Water Main	500	LF	$120	$60,000
1.09	24-inch Directional Boring	0	LF	$500	$0
1.10	24-inchSteel Encasement	0	LF	$600	$0
1.11	16-inch Valves	1	Each	$16,000	$16,000
1.12	Access Roads	1.0	Mi	$75,000	$75,000
1.13	Road Repairs	0	Sq. Yd.	$75	$0
1.14	Clean Up, Finish Grading, Seeding, Mulch	10	Acres	$7,500	$75,000
				Subtotal	**$3,143,000**
1.15	Contingencies (30% of Construction Total)				942,900
				Construction Subtotal	**$4,085,900**
2.00	**Engineering Services (10% of Construction Subtotal)**			**Engineering Subtotal**	**$408,600**
3.00	**Other Professional Services & Miscellaneous**				
3.01	Appraisals / Descriptions (10% of Land Acquisition)				$5,300
3.02	Land Acquisition	18	Acres	$2,900	$52,200
				Other Professional Services and Miscellaneous Subtotal	**$57,500**
4.00	**Mitigation Cost**				
4.01	Mitigation	1	LS	$150,000	$150,000
				Mitigation Subtotal	**$150,000**
				PIC	**$4,702,000**
				PO&M	**$266,200**
				Salvage Value	**$52,200**
				PPWV	**$4,916,000**

*CY = Cubic Yards
LF = Linear Feet
LS = Lump Sum
Mi = Miles
SF = Square Feet
Sq. Yd. = Square Yards

Little Otter Creek Reservoir – Proposed Action (MA1)

This alternative is the Proposed Action and is described in Section 2. The construction of the dam would require an estimated 519 acres of land acquisition, 860,000 cubic yards of structural earth fill, 16,000 cubic yards of riprap, and $2,100,000 in miscellaneous dam appurtenances.

A 500-LF raw water main would be constructed from the MA1 dam to transfer water to the proposed water treatment plant. This alternative would require an estimated 60 acres of clearing and grubbing, 1 16-inch valve, 1 mile of access road, and 70 acres of cleanup, finish grading, seeding, and mulch.

This alternative provides a water supply that requires a water treatment plant and a water intake structure. This alternative also provides recreation and has 189 parking spaces and 2 driving lanes.

Multi Purpose Alternative					
Opinion of Probable Project Cost					
Little Otter Creek Reservoir (MA1)					
1.00	**Construction**	**Quantity**	**Unit***	**Unit Cost**	**Total**
1.01	Mobilization, Bonding, Insurance	1	LS	$880,000	$880,000
1.02	Structural Earth Fill	860,000	CY	$6.00	$5,160,000
1.03	Riprap	16,000	CY	$65	$1,040,000
1.04	Principal Spillway	1	LS	$440,000	$440,000
1.05	Water Intake Structure	1	Each	$425,000	$425,000
1.06	Contractor Construction Staking	1	LS	$365,000	$365,000
1.07	Erosion Control	1	LS	$83,000	$83,000
1.08	Instrumentation	1	LS	$20,000	$20,000
1.09	Miscellaneous Dam Appurtenances	1	LS	$2,100,000	$2,100,000
1.10	Clearing and Grubbing	60	Acres	$10,000	$600,000
1.11	16-inch Raw Water Main	500	LF	$120	$60,000
1.12	16-inch Valves	1	Each	$16,000	$16,000
1.13	Access Roads	1	Mi	$75,000	$75,000
1.14	Clean Up, Finish Grading, Seeding, Mulch	70	Acres	$7,500	$525,000
				Construction Subtotal	**$11,789,000**
2.00	**Engineering Services (10% of Construction Subtotal)**			**Engineering Subtotal**	**$1,178,900**
3.00	**Other Professional Services & Miscellaneous**				
3.01	Appraisals / Descriptions (10% of Land Acquisition)				$150,600
3.02	Land Acquisition	519	Acres	$2,900	$1,505,100
				Other Professional Services and Miscellaneous Subtotal	**$1,655,700**
4.00	**Recreation Cost**				
4.01	Parking Lot Drive Lane Construction	2	Lanes	$96,300	$192,600
4.02	Parking Lot	189	Spaces	$1,620	$306,200
				Other Professional Services and Miscellaneous Subtotal	**$498,800**
5.00	**Mitigation Cost**				
5.01	Mitigation	1	LS	$2,000,000	$2,000,000
				Mitigation Subtotal	**$2,000,000**
				PIC	**$17,120,000**
				PO&M	**$768,000**
				Salvage Value	**$1,505,100**
				PPWV	**$16,390,000**

*CY = Cubic Yards
LF = Linear Feet
LS = Lump Sum
Mi = Miles
SF = Square Feet
Sq. Yd. = Square Yards

Alternative Reservoir Location – Site 2 (DPA1)

This alternative is described in Section 2. The construction of the dam would require an estimated 328 acres of land acquisition, 1,702,800 cubic yards of structural earth fill, 31,700 cubic yards of riprap, and $2,100,000 in miscellaneous dam appurtenances.

A 500-LF raw water main would be constructed from the DPA1 dam to transfer water to the proposed water treatment plant. This alternative would require an estimated 54 acres of clearing and grubbing, 1 16-inch valve, 1 mile of access roads, and 31 acres of cleanup, finish grading, seeding, and mulch.

This alternative provides a water supply that requires a water treatment plant. This alternative also provides recreation and will have 189 parking spaces and 2 driving lanes.

Dual Purpose Alternative					
Opinion of Probable Project Cost					
Alternative Reservoir Location - Site 2 (DPA1)					
1.00	**Construction**	**Quantity**	**Unit***	**Unit Cost**	**Total**
1.01	Mobilization, Bonding, Insurance	1	LS	$1,386,000	$1,386,000
1.02	Structural Earth Fill	1,702,800	CY	$6.00	$10,216,800
1.03	Riprap	31,700	CY	$65	$2,060,500
1.04	Principal Spillway	1	LS	$440,000	$440,000
1.05	Water Intake Structure	1	Each	$425,000	$425,000
1.06	Contractor Construction Staking	1	LS	$365,000	$365,000
1.07	Erosion Control	1	LS	$83,000	$83,000
1.08	Instrumentation	1	LS	$20,000	$20,000
1.09	Miscellaneous Dam Appurtenances	1	LS	$2,100,000	$2,100,000
1.10	Clearing and Grubbing	54	Acres	$10,000	$536,000
1.11	Intermediate Booster Pump Station	0	Each	$750,000	$0
1.12	16-inch Raw Water Main	500	LF	$120	$60,000
1.13	16-inch Valves	1	Each	$16,000	$16,000
1.14	16-inch Directional Boring	0	LF	$300	$0
1.15	24-inch Directional Boring	0	LF	$500	$0
1.16	24-inch Steel Encasement	0	LF	$600	$0
1.17	Access Roads	1	Mi	$16,000	$16,000
1.18	Road Repairs	0	Sq. Yd.	$75	$0
1.19	Clean Up, Finish Grading, Seeding, Mulch	31	Acres	$7,500	$232,500
				Subtotal	$17,896,800
1.20	Contingencies (30% of Construction Total)				5,369,100
				Construction Subtotal	**$23,265,900**
2.00	**Engineering Services (10% of Construction Subtotal)**			**Engineering Subtotal**	**$2,326,600**
3.00	**Other Professional Services & Miscellaneous**				
3.01	Appraisals / Descriptions (10% of Land Acquisition)				$95,200
3.02	Land Acquisition	328	Acres	$2,900	$951,200
				Other Professional Services and Miscellaneous Subtotal	**$1,046,400**
4.00	**Recreation Cost**				
4.01	Parking Lot Drive Lane Construction	2	Lanes	$96,300	$192,600
4.02	Parking Lot	189	Spaces	$1,620	$306,200
				Other Professional Services and Miscellaneous Subtotal	**$498,800**
5.00	**Mitigation Cost**				
5.01	Mitigation	1	LS	$1,350,000	$1,350,000
				Mitigation Subtotal	**$1,350,000**
				PIC	**$28,490,000**
				PO&M	**$1,584,300**
				Salvage Value	**$951,200**
				PPWV	**$29,120,000**

*CY = Cubic Yards LF = Linear Feet LS = Lump Sum Mi = Miles SF = Square Feet Sq. Yd. = Square Yards

Alternative Reservoir Location – Site 3 (DPA2)

This alternative is described in Section 2. The construction of the dam would require an estimated 390 acres of land acquisition, 860,000 cubic yards of structural earth fill, 16,000 cubic yards of riprap, and $2,100,000 in miscellaneous dam appurtenances.

A 500-LF raw water main would be constructed from the DPA2 dam to transfer water to the proposed water treatment plant. This alternative would require an estimated 57 acres of clearing and grubbing, 1 16-inch valve, one mile of access road, and 31 acres of cleanup, finish grading, seeding, and mulch.

This alternative provides a water supply that requires a water treatment plant. This alternative also provides recreation and will have 117 parking spaces and two driving lanes.

Dual Purpose Alternative					
Opinion of Probable Project Cost					
Alternative Reservoir Location - Site 3 (DPA2)					
1.00	**Construction**	**Quantity**	**Unit***	**Unit Cost**	**Total**
1.01	Mobilization, Bonding, Insurance	1	LS	$842,000	$842,000
1.02	Structural Earth Fill	860,000	CY	$6.00	$5,160,000
1.03	Riprap	16,000	CY	$65	$1,040,000
1.04	Principal Spillway	1	LS	$440,000	$440,000
1.05	Water Intake Structure	1	Each	$425,000	$425,000
1.06	Contractor Construction Staking	1	LS	$365,000	$365,000
1.07	Erosion Control	1	LS	$83,000	$83,000
1.08	Instrumentation	1	LS	$20,000	$20,000
1.09	Miscellaneous Dam Appurtenances	1	LS	$2,100,000	$2,100,000
1.10	Clearing and Grubbing	57	Acres	$10,000	$566,000
1.11	Intermediate Booster Pump Station	0	Each	$750,000	$0
1.12	16-inch Raw Water Main	500	LF	$120	$60,000
1.13	16-inch Valves	1	Each	$16,000	$16,000
1.14	16-inch Directional Boring	0	LF	$300	$0
1.15	24-inch Directional Boring	0	LF	$500	$0
1.16	24-inch Steel Encasement	0	LF	$600	$0
1.17	Access Roads	1	Mi	$16,000	$16,000
1.18	Road Repairs	0	Sq. Yd.	$75	$0
1.19	Clean Up, Finish Grading, Seeding, Mulch	31	Acres	$7,500	$232,500
				Subtotal	**$11,365,500**
1.20	Contingencies (30% of Construction Total)				3,409,700
				Construction Subtotal	**$14,775,200**
2.00	**Engineering Services (10% of Construction Subtotal)**			**Engineering Subtotal**	**$1,477,500**
3.00	**Other Professional Services & Miscellaneous**				
3.01	Appraisals / Descriptions (10% of Land Acquisition)				$101,800
3.02	Land Acquisition	351	Acres	$2,900	$1,017,900
				Other Professional Services and Miscellaneous Subtotal	**$1,119,700**
4.00	**Recreation Cost**				
4.01	Parking Lot Drive Lane Construction	2	Lanes	$96,300	$192,600
4.02	Parking Lot	117	Spaces	$1,620	$189,600
				Other Professional Services and Miscellaneous Subtotal	**$382,200**
5.00	**Mitigation Cost**				
5.01	Mitigation	1	LS	$1,700,000	$1,700,000
				Mitigation Subtotal	**$1,700,000**
				PIC	**$19,450,000**
				PO&M	**$1,031,200**
				Salvage Value	**$1,017,900**
				PPWV	**$19,470,000**

*CY = Cubic Yards LF = Linear Feet LS = Lump Sum Mi = Miles SF = Square Feet Sq. Yd. = Square Yards

Alternative Reservoir Location – Site 4 (DPA3)

This alternative is described in Section 2. The construction of the dam would require an estimated 741 acres of land acquisition, 1,033,100 cubic yards of structural earth fill, 19,300 cubic yards of riprap, and $2,100,000 in miscellaneous dam appurtenances.

A 500-LF raw water main would be constructed from the DPA3 dam to transfer water to the proposed water treatment plant. This alternative would require an estimated 109 acres of clearing and grubbing, 1 16-inch valve, 1 mile of access roads, and 61 acres of cleanup, finish grading, seeding, and mulch.

This alternative provides a water supply that requires a water treatment plant. This alternative also provides recreation and will have 247 parking spaces and two driving lanes.

Dual Purpose Alternative					
Opinion of Probable Project Cost					
Alternative Reservoir Location- Site 4 (DPA3)					
1.00	**Construction**	**Quantity**	**Unit***	**Unit Cost**	**Total**
1.01	Mobilization, Bonding, Insurance	1	LS	$1,062,000	$1,062,000
1.02	Structural Earth Fill	1,033,100	CY	$6.00	$6,198,600
1.03	Riprap	19,300	CY	$65	$1,254,500
1.04	Principal Spillway	1	LS	$440,000	$440,000
1.05	Water Intake Structure	1	Each	$425,000	$425,000
1.06	Contractor Construction Staking	1	LS	$365,000	$365,000
1.07	Erosion Control	1	LS	$83,000	$83,000
1.08	Instrumentation	1	LS	$20,000	$20,000
1.09	Miscellaneous Dam Appurtenances	1	LS	$2,100,000	$2,100,000
1.10	Clearing and Grubbing	109	Acres	$10,000	$1,086,000
1.11	Intermediate Booster Pump Station	0	Each	$750,000	$0
1.12	16-inch Raw Water Main	500	LF	$120	$60,000
1.13	16-inch Valves	1	Each	$16,000	$16,000
1.14	16-inch Directional Boring	0	LF	$300	$0
1.15	24-inch Directional Boring	0	LF	$500	$0
1.16	24-inch Steel Encasement	0	LF	$600	$0
1.17	Access Roads	1	Mi	$16,000	$16,000
1.18	Road Repairs	0	Sq. Yd.	$75	$0
1.19	Clean Up, Finish Grading, Seeding, Mulch	61	Acres	$7,500	$457,500
				Subtotal	**$13,523,600**
1.20	Contingencies (30% of Construction Total)				4,057,100
				Construction Subtotal	**$17,580,700**
2.00	**Engineering Services (10% of Construction Subtotal)**			**Engineering Subtotal**	**$1,758,100**
3.00	**Other Professional Services & Miscellaneous**				
3.01	Appraisals / Descriptions (10% of Land Acquisition)				$214,900
3.02	Land Acquisition	741	Acres	$2,900	$2,148,900
				Other Professional Services and Miscellaneous Subtotal	**$2,363,800**
4.00	**Recreation Cost**				
4.01	Parking Lot Drive Lane Construction	2	Lanes	$96,300	$192,600
4.02	Parking Lot	247	Spaces	$1,620	$400,140
				Other Professional Services and Miscellaneous Subtotal	**$592,700**
5.00	**Mitigation Cost**				
5.01	Mitigation	1	LS	$2,950,000	$2,950,000
				Mitigation Subtotal	**$2,950,000**
				PIC	**$25,250,000**
				PO&M	**$1,213,900**
				Salvage Value	**$2,148,900**
				PPWV	**$24,310,000**

*CY = Cubic Yards LS = Lump Sum SF = Square Feet LF = Linear Feet Mi = Miles Sq. Yd. = Square Yards

Alternative Reservoir Location – Site 5 (DPA4)

This alternative is described in Section 2. The construction of the dam would require an estimated 642 acres of land acquisition, 999,000 cubic yards of structural earth fill, 18,600 cubic yards of riprap, and $2,100,000 in miscellaneous dam appurtenances.

A 500-LF raw water main would be constructed from the DPA4 dam to transfer water to the proposed water treatment plant. This alternative would require an estimated 95 acres of clearing and grubbing, 1 16-inch valve, 1 mile of access road, and 61 acres of cleanup, finish grading, seeding, and mulch.

This alternative provides a water supply that requires a water treatment plant. This alternative also provides recreation and will have 214 parking spaces and two driving lanes.

Dual Purpose Alternative					
Opinion of Probable Project Cost					
Alternative Reservoir Location - Site 5 (DPA4)					
1.00	**Construction**	**Quantity**	**Unit***	**Unit Cost**	**Total**
1.01	Mobilization, Bonding, Insurance	1	LS	$972,000	$972,000
1.02	Structural Earth Fill	999,000	CY	$6.00	$5,994,000
1.03	Riprap	18,600	CY	$65	$1,209,000
1.04	Principal Spillway	1	LS	$440,000	$440,000
1.05	Water Intake Structure	1	Each	$425,000	$425,000
1.06	Contractor Construction Staking	1	LS	$365,000	$365,000
1.07	Erosion Control	1	LS	$83,000	$83,000
1.08	Instrumentation	1	LS	$20,000	$20,000
1.09	Miscellaneous Dam Appurtenances	1	LS	$2,100,000	$2,100,000
1.10	Clearing and Grubbing	95	Acres	$10,000	$954,000
1.11	Intermediate Booster Pump Station	0	Each	$750,000	$0
1.12	16-inch Raw Water Main	500	LF	$120	$60,000
1.13	16-inch Valves	1	Each	$16,000	$16,000
1.14	16-inch Directional Boring	0	LF	$300	$0
1.15	24-inch Directional Boring	0	LF	$500	$0
1.16	24-inch Steel Encasement	0	LF	$600	$0
1.17	Access Roads	1	Mi	$16,000	$16,000
1.18	Road Repairs	0	Sq. Yd.	$75	$0
1.19	Clean Up, Finish Grading, Seeding, Mulch	61	Acres	$7,500	$457,500
				Subtotal	**$13,111,500**
1.20	Contingencies (30% of Construction Total)				3,933,500
				Construction Subtotal	**$17,045,000**
2.00	**Engineering Services (10% of Construction Subtotal)**			**Engineering Subtotal**	**$1,704,500**
3.00	**Other Professional Services & Miscellaneous**				
3.01	Appraisals / Descriptions (10% of Land Acquisition)				$186,200
3.02	Land Acquisition	642	Acres	$2,900	$1,861,800
				Other Professional Services and Miscellaneous Subtotal	**$2,048,000**
4.00	**Recreation Cost**				
4.01	Parking Lot Drive Lane Construction	2	Lanes	$96,300	$192,600
4.02	Parking Lot	214	Spaces	$1,620	$346,700
				Other Professional Services and Miscellaneous Subtotal	**$539,300**
5.00	**Mitigation Cost**				
5.01	Mitigation	1	LS	$2,800,000	$2,800,000
				Mitigation Subtotal	**$2,800,000**
				PIC	**$24,140,000**
				PO&M	**$3,640,200**
				Salvage Value	**$1,861,800**
				PPWV	**$25,920,000**

*CY = Cubic Yards LF = Linear Feet LS = Lump Sum Mi = Miles SF = Square Feet Sq. Yd. = Square Yards

Floodplain Acquisition (FA2)

This alternative is described in Section 2. This alternative would require land acquisition of an estimated 312 acres.

Flood Damage Reduction Alternative					
Opinion of Probable Project Cost					
Floodplain Acquisition (FA2)					
1.00	**Other Professional Services & Miscellaneous**				
1.01	Appraisals / Descriptions				$18,100
1.02	Land Acquisition	312	Acres	$2,900	$904,800
				Subtotal	**$922,900**
				PIC	**$922,900**
				PO&M	**$60,200**
				Salvage Value	**$904,800**
				PPWV	**$78,300**

Small Detention Structures (FA8)

This alternative is described in Section 2. This alternative would require 161,000 cubic yards of structural earth fill, 1,336 LF of 8-inch concrete pipe, 63 LF of 18-inch concrete pipe, 145 LF of 36-inch concrete pipe, 74 LF of 48-inch concrete pipe, 57 LF of 54-inch concrete pipe, and 156 acres of land acquisition.

Flood Damage Reduction Alternative					
Opinion of Probable Project Cost					
Small Detention Structures (FA8)					
1.00	**Construction**	**Quantity**	**Unit**	**Unit Cost**	**Total**
1.01	Mobilization, Bonding, Insurance	1	LS	$269,000	$269,000
1.02	Structural Earth Fill	161,000	CY	$20	$3,220,000
1.03	8-inch Concrete Pipe Class V	1,336	LF	$65	$86,800
1.04	18-inch Concrete Pipe Class V	63	LF	$100	$6,300
1.05	36-inch Concrete Pipe Class V	145	LF	$150	$21,800
1.06	48-inch Concrete Pipe Class V	74	LF	$185	$13,700
1.07	54-inch Concrete Pipe Class V	57	LF	$240	$13,700
				Subtotal	**$3,631,300**
1.08	Contingencies (30% of Construction Total)				$1,089,400
				Construction Subtotal	**$4,721,000**
2.00	**Engineering Services (10% of Construction Subtotal)**			**Engineering Subtotal**	**$472,100**
3.00	**Other Professional Services & Miscellaneous**				
3.01	Appraisals / Descriptions				$9,100
3.02	Land Acquisition	156	Acres	$2,900	$452,400
				Other Professional Services and Miscellaneous Subtotal	**$461,500**
4.00	**Mitigation**				
4.01	Mitigation	1	LS	$100,000	$100,000
				Mitigation Subtotal	**$100,000**
				PIC	**$5,755,000**
				PO&M	**$768,900**
				Salvage Value	**$452,400**
				PPWV	**$6,071,000**

CY = Cubic Yards
LF = Linear Feet
LS = Lump Sum

Dry Dam Detention 100-year (FA9)

This alternative is described in Section 2 of the report. This alternative would require dry detention and 200 acres of land acquisition.

Flood Damage Reduction Alternative					
Opinion of Probable Project Cost					
Dry Dam Detention 100-yr (FA9)					
1.00	**Construction**	**Quantity**	**Unit**	**Unit Cost**	**Total**
1.01	Mobilization, Bonding, Insurance	1	LS	$692,000	$692,000
1.02	Dry Dam Detention	1	LS	$8,650,000	$8,650,000
				Subtotal	**$9,342,000**
1.03	Contingencies (30% of Construction Total)				$2,802,600
				Construction Subtotal	**$12,145,000**
2.00	**Engineering Services (10% of Construction Subtotal)**			**Engineering Subtotal**	**$1,214,500**
3.00	**Other Professional Services & Miscellaneous**				
3.01	Appraisals / Descriptions				$11,600
3.02	Land Acquisition	200	Acres	$2,900	$580,000
				Other Professional Services and Miscellaneous Subtotal	**$591,600**
4.00	**Mitigation Cost**				
4.01	Mitigation	1	LS	$50,000	$50,000
				Mitigation Subtotal	**$50,000**
				PIC	**$14,000,000**
				PO&M	**$791,200**
				Salvage Value	**$580,000**
				PPWV	**$14,210,000**

LS = Lump Sum

Dry Dam Detention 50-year Storage (FA10)

This alternative is described in Section 2 of the report. This alternative would require dry detention and 140 acres of land acquisition.

Flood Damage Reduction Alternative					
Opinion of Probable Project Cost					
Dry Dam Detention 50-yr Storage (FA10)					
1.00	**Construction**	**Quantity**	**Unit**	**Unit Cost**	**Total**
1.01	Mobilization, Bonding, Insurance	1	LS	$388,000	$388,000
1.02	Dry Dam Detention	1	LS	$4,217,000	$4,217,000
				Subtotal	**$4,605,000**
1.03	Contingencies (30% of Construction Total)				$1,381,500
				Construction Subtotal	**$5,987,000**
2.00	**Engineering Services (10% of Construction Subtotal)**			**Subtotal**	**$598,700**
3.00	**Other Professional Services & Miscellaneous**				
3.01	Appraisals / Descriptions				$8,200
3.02	Land Acquisition	140	Acres	$2,900	$406,000
				Other Professional Services and Miscellaneous Subtotal	**$414,200**
4.00	**Mitigation Cost**				
4.01	Mitigation	1	LS	$50,000	$50,000
				Mitigation Subtotal	**$50,000**
				PIC	**$7,050,000**
				PO&M	**$390,100**
				Salvage Value	**$406,000**
				PPWV	**$7,034,000**

LS = Lump Sum

Create Stream Access (RA1)

This alternative is described in Section 2 of the report. This alternative would require construction of three stream access locations and 6 acres of land acquisition.

Recreation Alternative					
Opinion of Probable Project Cost					
Create Stream Access (RA1)					
1.00	**Construction**	**Quantity**	**Unit**	**Unit Cost**	**Total**
1.01	Mobilization, Bonding, Insurance	1	LS	$70,000	$70,000
1.02	Clearing and Grubbing	6	Acres	$10,000	$60,000
1.03	Parking Lot Drive Lane Construction	3	Lanes	$96,300	$288,900
1.04	Parking Lot	30	Spaces	$1,620	$48,600
1.05	Boat Ramps	3	L.S.	$20,000	$60,000
1.06	Clean Up, Finish Grading, Seeding, Mulch	6	Acres	$7,500	$45,000
				Subtotal	**$572,500**
1.03	Contingencies (30% of Construction Total)				$171,800
				Construction Subtotal	**$744,300**
2.00	**Engineering Services (10% of Construction Subtotal)**			**Subtotal**	**$74,500**
3.00	**Other Professional Services & Miscellaneous**				
3.01	Appraisals / Descriptions				$1,800
3.02	Land Acquisition	6	Acres	$2,900	$17,400
				Other Professional Services and Miscellaneous Subtotal	**$19,200**
				PIC	**$838,300**
				PO&M	**$48,500**
				Salvage Value	**$17,400**
				PPWV	**$869,100**

LS = Lump Sum